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Contractors' and Engineers' Monthly

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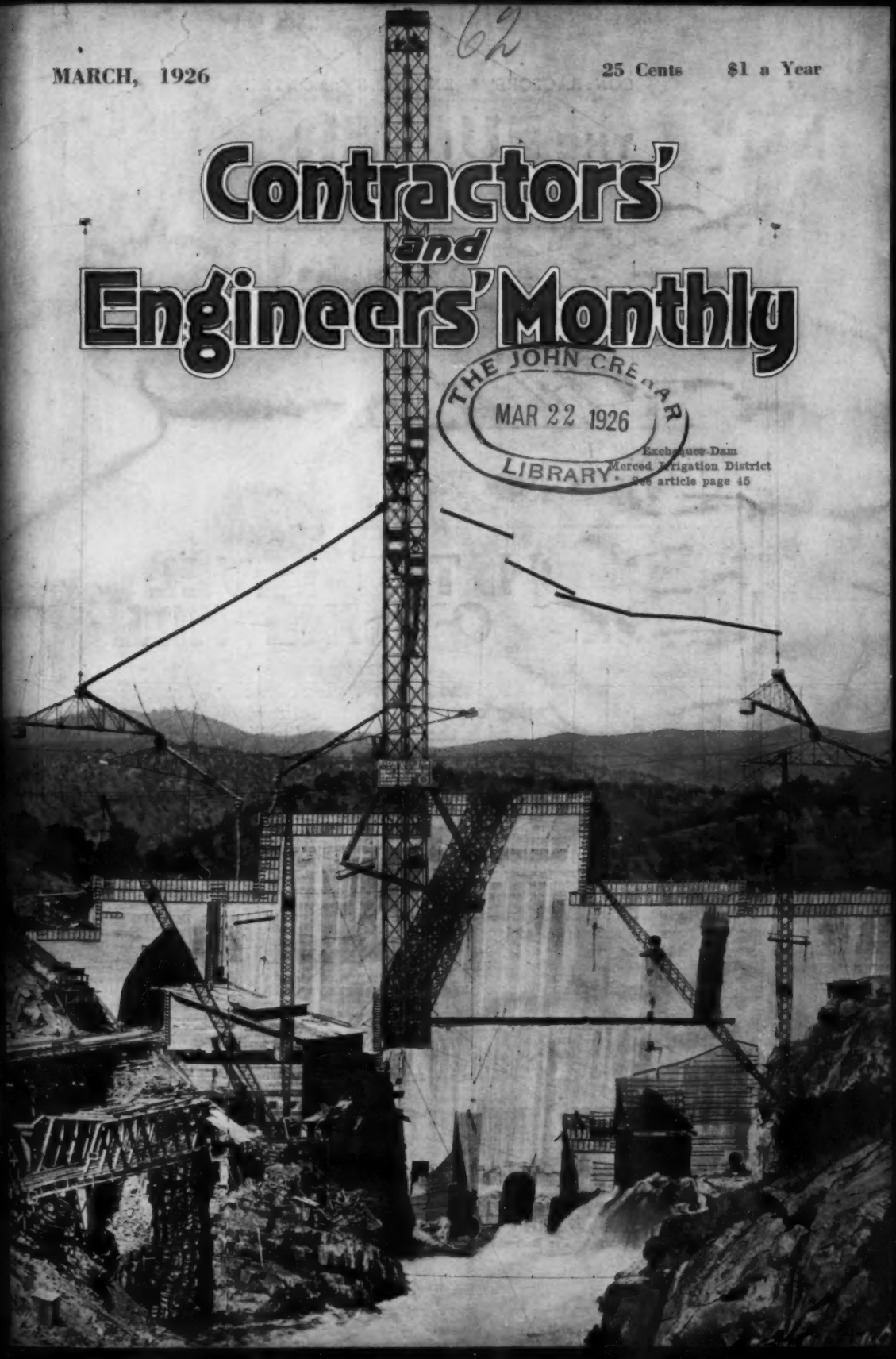

Exchequer Dam
Merced Irrigation District
See article page 45

THE FULLER
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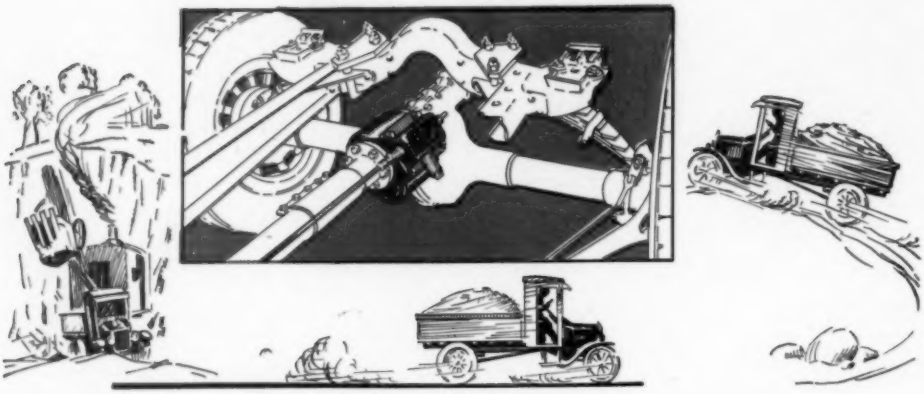
FOR FORD TRUCKS



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VOL. XII. No. 3 CONTRACTORS' & ENGINEERS' MONTHLY March, 1926
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Where to Purchase

A comprehensive classification of the leading machinery and supply manufacturers arranged for the convenience of contractors, engineers and public officials who may wish to secure information about construction equipment.
The Index to Advertisers faces the inside back cover. When writing to advertisers please mention the CONTRACTORS' & ENGINEERS' MONTHLY. A star (*) before the manufacturer's name indicates that his advertisement appears in this issue.

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Peerless P. C. Co., Union City, Mich.
Peninsular P. C. Co., Cement City, Mich.
Penn-Allen Cement Co., Allentown, Pa.
Petoskey P. C. Co., Petoskey, Mich.
Phoenix P. C. Co., Nazareth, Pa.
Pgh. Plate Glass Co., Pittsburgh, Pa.
P. C. Co. of Utah, Salt Lake City.
Pyramid P. C. Co., Des Moines
Riverside P. C. Co., Los Angeles.
St. Marys Cement Co., Toronto, Can.
San Antonio P. C. Co., San Antonio.
Sandusky Cement Co., Cleveland, O.
Santa Cruz P. C. Co., San Francisco.
Signal Mountain P. C. Co., Chatta., Tenn.
Southern States P. C. Co., Rockport, Ga.
Southwest'n P. C. Co., El Paso, Tex.
Sun P. C. Co., Portland, Ore.
Superior P. C. Co., Seattle, Wash.
Texas P. C. Co., Dallas, Tex.
Three Forks P. C. Co., Denver, Colo.
Tidewater P. C. Co., Baltimore, Md.
Trinity P. C. Co., Dallas, Tex.
Union P. C. Co., Ogden, Utah
U. S. P. C. Co., Denver, Colo.
Universal P. C. Co., Chicago
Utah Idaho Cement Co., Ogden, Utah
Vulcanite P. C. Co., Philadelphia
Wabash P. C. Co., Detroit
Wolverine P. C. Co., Coldwater, Mich.
Wyandotte P. C. Co., Detroit

CEMENT BLOCK MACHINES
*Cement Block Mach. Co., Newark, N. J.

CEMENT GUNS
Cement Gun Co., Allentown, Pa.

CEMENT INSPECTION (See Inspecting Laboratories)

CEMENT TOOLS
*Abrams Cement Tool Co., Detroit

CENTRIFUGAL PUMPS (See "Pumps, Centrifugal")

CHAINS
Amer. Chain Co., Inc., Bridgeport, Conn.
Chain Belt Co., Milwaukee, Wis.
Columbus McKinnon Chain Co., Columbus, O.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago
U. S. Chain & Forge Co., Pittsburgh, Pa.
Webster Mfg. Co., Chicago
Weller Mfg. Co., Chicago

CHIMNEYS, CONCRETE
Heine Chimney Co., Chicago
Rust Engineering Co., Pittsburgh, Pa.
Weber Chimney Co., Chicago

CHIMNEYS, RADIAL BRICK
Amer. Chimney Corp., N. Y.
Alphons Custodis Chimney Const. Co. N.Y.
Continental Chimney Co. of Chi., Chicago
Heine Chimney Co., Chicago
H. R. Heinicke, Inc., Indianapolis, Ind.
M. W. Kellogg & Co., N. Y.
Rust Eng. Co., Pittsburgh, Pa.

CHIMNEYS, STEEL (See Stacks, Steel)

CHLORINATORS
*Wallace & Tiernan Co., Inc., Newark, N. J.

CHLORINE, LIQUID
(See Liquid Chlorine)

CHUTES, CONCRETE
*Insley Mfg. Co., Indianapolis, Ind.
*Lakewood Eng. Co., Cleveland, O.
*Ransome Conc. Mchy. Co., Dunellen, N.J.

CLIPS, WIRE ROPE
*Amer. Hoist & Derrick Co., St. Paul, Minn.
Fischer & Hayes Rope & Steel Co., Chicago
Marion Malleable Ir. Wks., Marion, Ind.
O. M. Mockbee & Co., Cincinnati, O.
John A. Roebling Sons Co., Trenton, N.J.
Upson-Walton Co., Cleveland, O.

CLUTCHES
*Twin Disc Clutch Co., Racine, Wis.
*Waukesha Motor Co., Waukesha, Wis.

COAL AND ORE CONVEYING MCHY.
*Barber-Greene Co., Aurora, Ill.
*Good Roads Machy. Co., Kennett Sq., Pa.
*Chicago Automatic Conv. Co., Chicago
*Geo. Haiss Mfg. Co., N. Y.
*Lidgerwood Mfg. Co., N. Y.
*Mead-Morrison Mfg. Co., E. Boston.
C. O. Bartlett & Snow Co., Cleveland, O.
Brown Hoisting Mchy. Co., Cleveland, O.
Chain Belt Co., Milwaukee, Wis.
Fairfield Eng. Co., Marion, O.
Gifford-Wood Co., Hudson N. Y.
C. W. Hunt Co., Inc., W. New Brighton, N. Y.
Jeffrey Mfg. Co., Columbus, O.
Kon-Wald Co., Buffalo, N. Y.
Link-Belt Co., Chicago.
Morrow Mfg. Co., Wellston, Ohio.
Portable Machinery Co., Passaic, N. J.
Robins Conv. Belt Co., N. Y.
Webster Mfg. Co., Chicago
Weller Mfg. Co., Chicago.

COCKS, CURB AND CORPORATION
*Union Wtr. Mtr. Co., Worcester, Mass.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Glauber Brass Mfg. Co., Cleveland, O.
Haydenville Co., Haydenville, Mass.
Hays Mfg. Co., Erie, Pa.
Mueller Co., Decatur, Ill.

COLLAPSIBLE HORSES
*Taylor Collapsible Horse Co., Chicago.

COLUMN CLAMPS
*Insley Mfg. Co., Indianapolis, Ind.
*M. & M. Wire Clamp Co., Minneapolis
The O. D. G. Co., Owensboro, Ky.
Victor L. Phillips Co., Kansas City, Mo.
Sterling Wheelbarrow Co., Milwaukee.
Symons Clamp & Mfg. Co., Chicago.
Universal Form Clamp Co., Chicago

COMPRESSORS, AIR (See Air Compressors)

CONCRETE BLOCK MACHINES (See Cement Block Machines)

CONCRETE FLOOR HARDENER
Anti-Hydro Waterproofing Co., Newark, N. J.

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Every day you hear of contractors losing money because they are unable to finish their jobs on time.

Contractors who "know the game" use dependable equipment which does not break down under the strain of constant service. They know that a crane laid up for repairs does not contribute much to their pocket book.

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CATALOGS SENT ON REQUEST

ORTON CRANE & SHOVEL CO., *FORMERLY* ORTON & STEINBRENNER CO

608 So. Dearborn St. — ORTON CRANE & SHOVEL CO — Chicago, Illinois

General Chemical Co., N. Y.
General Firepr. Co., Youngstown, O.
Granitex Corp., N. Y.
A. C. Horn Co., L. I. City, N. Y.
Master Builders Co., Cleveland, O.
L. Sonneborn Sons, Inc., N. Y.
Truscon Laboratories, Detroit.

CONCRETE HEATERS
*Aeroil Burner Co., Union Hill, N. J.
*Chausse Oil Burner Co., Elkhart, Ind.
*Hauck Mfg. Co., Brooklyn, N. Y.

CONCRETE MIXERS
*Amer. Cem. Mchy. Co., Inc., Keokuk, Ia.
*Atlas Eng. Co., Milwaukee, Wis.
*Construction Mchy. Co., Waterloo, Ia.
*Foote Conc. Mchy. Co., Chicago
*J. B. Foote Fdry. Co., Fredericktcn, O.
*Jaeger Mach. Co., Columbus, O.
*Kiehl Mixer Co., Milwaukee, Wis.
*Koehring Co., Milwaukee, Wis.
*Kwik-Mix Con. Mixer Co., Port Washington, Wis.
*Lakewood Eng. Co., Cleveland, O.
*Lansing Co., Lansing, Mich.
*Raber & Lang Mfg. Co., Kendallville, Ind.
*Ransome Con. Mchy. Co., Dunellen, N.J.
*Schramm, Inc., West Chester, Pa.
*T. L. Smith Co., Milwaukee, Wis.
*Standard Scale & Supply Co., Pittsburgh
Anchor Mfg. Co., Chicago.
Badger Con. Mixer Co, Milwaukee
Chain Belt Co., Milwaukee.
Contractors' Equip. Co., Keokuk, Ia.
B. M. Cropp Co., Chicago.
Gray Iron Fdry Co., Reading, Pa.
Judy Mfg. Co., Centerville, Ia.
Knickerbocker Co., Jackson, Mich.
Leach Co., Oshkosh, Wis.
Marsh-Capron Co., Chicago.
Milwaukee Conc. Mixer Co., Milwaukee.
Remmel Mfg. Co., Kewaskum, Wis.
Republic Ir. Wks. Tecumseh, Mich.
Truckmixer Co., Milwaukee.

CONCRETE PILING (See Piling)

CONCRETE PIPE (See Pipe, Concrete)

CONCRETE REINFORCEMENT
*Truscon Steel Co., Youngstown, O.
American Steel & Wire Co., Chicago.
Bethlehem Steel Co., Bethlehem, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Concrete Steel Co., N. Y.
Consolidated Exp. Metal Co., Braddock, Pa.
Electric Welding Co., Pittsburgh, Pa.
Ft. Pitt Bridge Wks, Pittsburgh, Pa.
General Fireproofing Co., Youngstown, O.
Inland Steel Co., Chicago.
Kalman Steel Co., Chicago.
Laclede Steel Co., St. Louis, Mo.
National Steel Fabric Co., Pittsburgh.
J. T. Ryerson & Son, Chicago.
Wickwire-Spencer Steel Co., N. Y.
Youngstown Pressed Steel Co., Warren, O.
Youngstown Sheet & Tube Co., Youngstown, O.

CONCRETE ROAD FINISHERS
*Heltzel Stl. Form & Iron Co., Warren, O.
*Lakewood Eng. Co., Cleveland, O.
Dunn Road Mach. Co., Conneaut, O.
A. W. French & Co., Chicago

CONCRETE SURFACING MACHINES
*Concrete Surfacing Machy. Corp., Cincinnati, O.
W. H. Keller, Inc., Grand Haven, Mich.

CONCRETE TOOLS
*The Dallett Co., Philadelphia.

CONDENSERS
*Ingersoll-Rand Co., N. Y.
Allis-Chalmers Mfg. Co., Milwaukee.
Dean Bros. Co., Indianapolis, Ind.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
Wheeler Cond. & Eng. Co., Carteret, N.J.
Worthington Pump & Machy Corp., N.Y.

CONDUIT RODS
F. Bissell Co., Toledo, O.
Turbine Sewer Mch. Co., Milwaukee.
Waldo Bros. & Bond Co., Boston.

CONDUITS, UNDERGROUND
Amer. Vitr. Products Co., Akron, O.
Johns-Manville Inc., N. Y.
National Fireproofing Co., N. Y.
Ric-wiL Co., Cleveland.

CONTRACTORS' EQUIPMENT DEALERS (See pages 167 to 183)

CONVEYORS, BELT
*Austin-Western Rd. Mchy, Co., Chicago
*Barber-Greene Co., Aurora, Ill.
*Chicago Automatic Conv. Co., Chicago
*Good Rds. Mchy. Co., Kennett Sq., Pa.
*Geo. Haiss Mfg. Co., N. Y.
*Russell Grader Mfg. Co., Minneapolis.
Brown Hoisting Machy. Co., Cleveland
Chain Belt Co., Milwaukee.
Gifford Wood Co., Hudson, N. Y.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago.
Samuel Olson & Co., Chicago.
Portable Machy Co., Passaic, N. J.
Robins Conv. Belt Co., N. Y.
Standard Conv. Co., No. St. Paul, Minn.
Webster Mfg. Co., Chicago.
Weller Mfg. Co., Chicago.

CONVEYORS, BUCKET
*Atlas Eng. Co., Milwaukee.
*Chicago Automatic Conv. Co., Chicago
*Good Rds. Machy. Co., Kennett Sq., Pa.
*Geo. Haiss Mfg. Co., N. Y.
*Mead-Morrison Mfg. Co., E. Boston.
*Russell Grader Mfg. Co., Minneapolis.
C. O. Bartlet & Snow Co., Cleveland, O.
Brown Hoisting Machy. Co., Cleveland, O.
H. W. Caldwell & Son, Chicago.
Chain Belt Co., Milwaukee.
Fairfield Eng. Co., Marion, O.
Gifford Wood Co., Hudson, N. Y.
Godfrey Conv. Co., Elkhart, Ind.
Guarantee Constn. Co., N. Y.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago.
Samuel Olson & Co., Chicago.
Republic Rubber Co., Youngstown, O.
Robins Conv. Belt Co., N. Y.
Stephens Adamson Mfg. Co., Aurora, Ill.
Webster Mfg. Co., Chicago.
Weller Mfg. Co., Chicago.

CONVEYORS, GRAVITY
Lamson Co., Syracuse, N. Y.
Logan Co., Louisville, Ky.
Mathews Gravity Carrier Co., Elwood City, Pa.
Standard Conv. Co., No. St. Paul, Minn.

COUPLINGS, HOSE
*Ingersoll-Rand Co., N. Y.
Cleveland Pneum. Tool Co., Cleveland, O.
Gilman Mfg. Co., East Boston, Mass.
W. H. Keller, Inc., Grand Haven, Mich.

CRANES, LOCOMOTIVE
*Bay City Dredge Wks., Bay City, Mich.
*Byers Machine Co., Ravenna, O.
*Erie Steam Shovel Co., Erie, Pa.
*Harnischfeger Corp., Milwaukee.
*Koehring Co., Milwaukee.
*Marion Steam Shovel Co., Marion, O.
*Orton Crane & Shovel Co., Chicago
Amer. Hst. & Derrick Co., St. Paul, Minn.
Brown Hoisting Machy Co., Cleveland.
Browning Co., Cleveland, O.
Bucyrus Co., So. Milwaukee, Wis.
Davenport Loc. Wks., Davenport, Ia.
Hanna Eng. Works, Chicago.
Industrial Wks., Bay City, Mich.
Link-Belt Co., Chicago.
Loc. Crane Co. of Amer., Champaign, Ill.
McMyler Interstate Co., Cleveland, O.
Northwest Eng. Works, Chicago.
Ohio Loc. Crane Co., Bucyrus, O.
Thew Shovel Co., Lorain, O.
U. S. Crane Co., Chicago.

CRANES, OVERHEAD TRAVELING
*Curtis Pneum. Mach. Co., St. Louis
*Harnischfeger Corp., Milwaukee.
Alliance Mach. Co., Alliance, O.
Chesapeake Iron Wks., Baltimore, Md.
Chisholm-Moore Mfg. Co., Cleveland, O.
Milwaukee Elec. Crane Co., Milwaukee.
Morgan Eng. Co., Alliance, O.
Northern Eng. Wks., Detroit, Mich.
Shaw Crane Wks., Muskegon, Mich.
Shepard Elec. Cr. & Hst. Co., Montour Falls, N. Y.
Toledo Crane Co., Bucyrus, O.
Whiting Fdry. & Equip. Co., Harvey, Ill.

CRANES, TRUCK
*Byers Machine Co., Ravenna, O.
*Harnischfeger Corp., Milwaukee.
*Orton Crane & Shovel Co., Chicago
Bay City Fdry. & Mach. Co., Bay City, Mich.
Universal Crane Co., Cleveland.

CRANES, WRECKING
Bucyrus Co., So. Milwaukee, Wis.
Industrial Wks., Bay City, Mich.

CRAWLER ATTACHMENTS
Geo. Haiss Mfg. Co., New York

CREOSOTED BLOCKS, TIMBER, ETC.
Amer. Creos. Co., Inc., Louisville, Ky.
Amer. Creos. Wks., Inc., N. Orleans, La.
Carter Bloxonend Flooring Co., K. City, Mo.
Colonial Cre. Co., Inc., Louisville, Ky.
Creos. Materials Co., N. Orleans, La.
Georgia Creos. Co., Louisville, Ky.
Jennison-Wright Co., Toledo, O.
Midland Creos. Co., Granite City, Ill.
Republic Creos. Co., Indianapolis, Ind.
Southern Wood Pres. Co., Atlanta, Ga.
Wyckoff Pipe & Creos. Co., N. Y.

CREOSOTING AND CREOSOTING OILS
*Barrett Co., N. Y.
Amer. Creos. Wks., Inc., N. Orleans, La.
Amer. Tar Prod. Co., Pittsburgh, Pa.
Jennison-Wright Co., Toledo, O.
Southern Creos. Co., Ltd., Slidell, La.
Southern Pavg. Const. Co., Chattanooga.
Wyckoff Pipe & Creos. Co., N. Y.

CRUSHERS, HEAVY DUTY
Allis-Chalmers Mfg. Co., Milwaukee.
O. G. Buchanan Co., N. Y.
Traylor Eng. & Mfg. Co., Allentown, Pa.

CRUSHERS, ROCK
*Acme Rd. Machy. Co., Frankfort, N. Y.
*Austin-Western Rd. Mach. Co., Chicago
*Galion Iron Wks. & Mfg. Co., Galion, O.
*Good Rds. Machy. Co., Kennett Sq., Pa.
*Russell Grader Mfg. Co., Minneapolis.
*Smith Eng. Wks., Milwaukee.
*Universal Rd Machy Co., Kingston, N.Y.
Morgan Eng. Co., Alliance, O.
New Holland Mach. Co., New Holland, Pa.
Sturtevant Mill Co., Boston.
Universal Crusher Co., Cedar Rapids, Ia.

CULVERTS, CAST IRON
*U. S. C. I. Pipe & Fdry. Co., Burlington, N. J.
Amer. C. I. Pipe Co., Birmingham, Ala.
Gilbert Mfg. Co., Aberdeen, S. D.
R. D. Wood & Co., Philadelphia

CULVERTS, CORRUGATED METAL
*Austin-Western Rd. Mach. Co., Chicago
*Galion Iron Wks. & Mfg. Co., Galion, O.
*Good Rds. Mach. Co., Kennett Sq., Pa.
*Newport Culvert Co., Newport, Ky.
Bark River Bridge & Culv. Co., Bark River, Mich.
Boardman Co., Okla. City, Okla.
Burnham Mfg. Co., Woods Cross, Utah.
Calif. Corr. Culv. Co., W. Berkeley, Cal.
Canada Ingot Ir. Co., Ltd., Guelph, Ont.
Canton Culv. & Silo Co., Canton, O.

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Gilbert Mfg. Co., Aberdeen, S. D.
R. Hardesty Mfg. Co., Denver, Colo.
Highway Prod. & Mfg. Co., Elmira, N.Y.
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Iowa Pure Ir. Co., Des Moines, Ia.
Klauer Mfg. Co., Dubuque, Ia.
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Md. Culv. & Metal Co., Baltimore.
N. E. Metal Culv. Co., Palmer, Mass.
Nebraska Culv. & Mfg. Co., Wahoo, Neb.
North East Metal Culv. Co. Nashua, N.H.
Northfield Ir. Co., Northfield, Minn.
Northw't'rn Sheet & Ir. Wks., Wahpeton, N. D.
Ohio Corr. Culv. Co., Middletown, O.
W. Q. O'Neall Co., Crawfordsville, Ind.
Road Supply & Metal Co., Topeka, Kan.
Sioux Falls Metal Culv. Co., Sioux Falls, S. D.
So. Metal Culv. Co., Salisbury, N. C.
Spokane Culv. & Tank Co., Spokane.
Tenn. Metal Culv. Co., Nashville.
U. S. Br. & Culv. Co., Bay City, Mich.
Va. Metal Mfg. Co., Roanoke, Va.
Western Metal Mfg. Co., Houston, Tex.
Wheeling Corr. Co., Wheeling, W. Va.
Wyatt Metal & Blr. Wks., Dallas, Tex.

CULVERT FORMS
Concrete Form Co., Inc., Syracuse, N.Y.
Northfield Iron Co., Northfield, Minn.

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Casey-Hedges Co., Chattanooga, Tenn.
H. W. Clark Co., Mattoon, Ill.
J. B. Clow & Sons, Chicago.
Madison Fdry. Co., Cleveland, O.
Mueller Co., Decatur, Ill.

CURB GUARDS, STEEL
*W. S. Godwin Co., Baltimore.

CURB, STEEL PROTECTED
*Truscon Steel Co., Youngstown, O.
Concrete Steel Co., N. Y.

CURING OF CONCRETE
*Dow Chemical Co., Midland, Mich.
*Solvay Process Co., N. Y.

CUTTERS, PIPE, HAND
Armstrong Mfg. Co., Bridgeport, Ct.
Barnes Tool Co., New Haven, Ct.
Erie Tool Works, Erie, Pa.
Greenfield Tap & Die Corp., Greenfield, Mass.
Oswego Tool Co., Oswego, N. Y.
Reed Mfg. Co., Erie, Pa.
Walworth Mfg. Co., Boston.

CUTTERS, ROD AND WIRE
*Koehring Co., Milwaukee, Wis.
Buffalo Forge Co., Buffalo, N. Y.
Carolus Mfg. Co., Sterling, Ill.
Helwig Mfg. Co., St. Paul, Minn.
Worthington Pump & Mchy Corp., N.Y.

CUTTING EDGES
*Russell Grader Mfg. Co., Minneapolis
J. D. Adams & Co., Indianapolis, Ind.
Shunk Mfg. Co., Bucyrus, O.

CUTTING AND WELDING APPARATUS
*Alex. Milburn Co., Baltimore.
MacLeod Co., Cincinnati, O.

DERRICKS, GUY AND STIFF-LEG
*Clyde Ir. Wks. Sales Co., Duluth, Minn.
*Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
*S. Flory Mfg. Co., Bangor, Pa.
*Insley Mfg. Co., Indianapolis, Ind.
*Lidgerwood Mfg. Co., N. Y.
*Saugen Derrick Co., Chicago.
*Universal Hstg. Machy Corp., Buffalo.
Amer. Hst. & Derrick Co., St. Paul, Minn.
Federal Br. & Struc. Co., Waukesha, Wis.
John T. Horton Co., N. Y.
Lakeside Bridge & Steel Co., N. Milwaukee, Wis.
National Hstg. Eng. Co., Harrison, N.J.
Superior Iron Wks., Superior, Wis.

DERRICKS, PIPE LAYING
*Dobbie Fdry. & Mach. Co., Niagara Falls
*Lidgerwood Mfg. Co., N. Y.
Mueller Co., Decatur, Ill.
Squier-Rix Co., Milwaukee.

DERRICKS, REVOLVING
*Clyde Iron Wks. Sales Co., Duluth, Minn.
*Dobbie Fdry. & Mach. Co., Niagara Falls
*Lidgerwood Mfg. Co., N. Y.

DERRICKS, STEEL
*Clyde Ir. Wks. Sales Co., Duluth, Minn.
*Dobbie Fdry. & Mach. Co., Niagara Falls.
*Insley Mfg. Co., Indianapolis, Ind.
*Lidgerwood Mfg. Co., N. Y.
Amer. Hst. & Derrick Co., St. Paul
Hayward Co., N. Y.
Lakeside Bri. & St. Co., N. Milwaukee
Taylor Port. St. Derrick Co., Chicago.

DERRICKS, STEEL PORTABLE
*Clyde Ir. Wks. Sales Co., Duluth, Minn.
*Dobbie Fdry. & Mach. Co., Niagara Falls.
*Lidgerwood Mfg. Co., N. Y.
Amer. Hst. & Derrick Co., St. Paul

DERRICKS, TRAVELING
*Bay City Dredge Wks., Bay City, Mich.
*Clyde Ir. Wks. Sales Co., Duluth, Minn.
*Dobbie Fdry. & Mach. Co., Niagara Falls.
*Orton Crane & Shovel Co., Chicago
Amer. Hst. & Derrick Co., St. Paul
Austin Machy Corp., Muskegon, Mich.
Hayward Co., N. Y.
Nat'l Hstg. Eng. Co., Harrison, N. J.

DERRICK FITTINGS
*S. Flory Mfg. Co., Bangor, Pa.
*Lidgerwood Mfg. Co., N. Y.

DIESEL ENGINES (See Engines, Oil)

DISTRIBUTORS, TAR AND ASPHALT
Kinney Mfg. Co., Boston

DISTRIBUTING PLANTS, CONCRETE
*Lakewood Eng. Co., Cleveland.
*Insley Mfg. Co., Indianapolis, Ind.
*Ransome Conc. Mchy. Co., Dunellen, N.J.
Archer Iron Works, Chicago.

DITCHING MACHINES (See Excavators)

DIVIDING PLATES (ROAD)
*W. S. Godwin Co., Baltimore

DOORS AND SHUTTERS, STEEL ROLLING
Cornell Iron Wks., Inc., N. Y.
Kinnear Mfg. Co., Columbus, O.
Variety Fire Door Co., Chicago.
J. G. Wilson Corp., N. Y.

DRAFTING MACHINES
Univ. Drafting Mach. Co., Cleveland, O.

DREDGES
*Bay City Dredge Wks., Bay City, Mich.
*Erie Steam Shovel Co., Erie, Pa.
*Lidgerwood Mfg. Co., N. Y.
*Marion Steam Shovel Co., Marion, O.
*Orton Crane & Shovel Co., Chicago
*Street Bros. Mach. Wks., Chattanooga
Amer. Steel Dredge Co., Ft. Wayne, Ind.
Street Bros. Mach. Wks., Chattanooga.
Bucyrus Co., So. Milwaukee, Wis.
Ellicott Machy Corp., Baltimore.
Hayward Co., N. Y.
Osgood Co., Marion O.
Stockton Iron Wks., Stockton, Cal.
Superior Iron Wks., Superior, Wis.

DREDGES, DIPPER
*Bay City Dredge Wks., Bay City, Mich.
*Marion Steam Shovel Co., Marion, O.
Amer. Steel Dredge Co., Ft. Wayne, Ind.
Austin Machy Corp., Muskegon, Mich.
Bucyrus Co., So. Milwaukee, Wis.
Osgood Co., Marion, O.

DREDGES, HYDRAULIC
*Marion Steam Shovel Co., Marion, O.
Bucyrus Co., South Milwaukee, Wis.
Ellicott Mach. Corp., Baltimore.
Morris Mach. Wks., Baldwinsville, N.Y.

DREDGING MACHINERY
*S. Flory Mfg. Co., Bangor, Pa.
*Lidgerwood Mfg. Co., N. Y.

DREDGING PUMPS AND ACCESSORIES
Erie Pump & Engine Wks., Medina, N.Y.

DRILLS, CORE
*Ingersoll-Rand Co., N. Y.
*McKiernan-Terry Drill Co., N. Y.
*Sullivan Machy. Co., Chicago.
Dobbins Core Drill Co., Inc., N. Y.
Standard Diamond Drill Co., Chicago.

DRILLS, ROCK
*Dallett Co., Philadelphia.
*Denver Rock Drill Mfg. Co., Denver.
*Ingersoll-Rand Co., N. Y.
*McKiernan-Terry Drill Co., N. Y.
*Sullivan Machy. Co., Chicago.
Chicago Pneum. Tool Co., N. Y.
Cleveland Pneum. Tool Co., Cleveland, O.
Cleveland Rock Drill Co., Cleveland, O.
Gilman Mfg. Co., E. Boston.
Helwig Mfg. Co., St. Paul, Minn.
Independent Pneum. Tool Co., Chicago.
W. H. Keller, Inc., Grand Haven, Mich.
Wood Drill Wks., Paterson, N. J.

DRILLS FOR WELLS AND BLAST HOLES (See Well Drilling Machy)

DRUMS, HOLDING
*Blaw-Knox Co., Pittsburgh, Pa.
*Clyde Ir. Wks. Sales Co., Duluth, Minn.
*Dobbie Fdry. & Mch. Co., Niagara Falls.
Hayward Co., N. Y.
Monighan Machine Co., Chicago.

DRYERS, ASPHALT AND CEMENT
Allis-Chalmers Mfg. Co., Milwaukee.
Amer. Blower Co., Detroit, Mich.
Amer. Process Co., N. Y.
Atlas Dryer Co., Cleveland, O.
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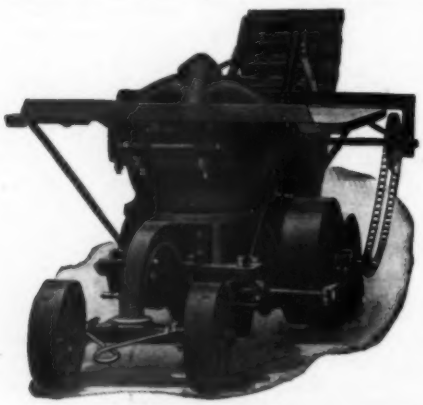

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*George Haiss Mfg. Co., N. Y.
*Spears-Wells Mchy. Co., Oakland, Cal.
Lessman Loader Mfg. Co., Des Moines, Ia.
Nelson Iron Wks., Passaic, N. J.
Specialty Eng. Co., Philadelphia, Pa.

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*Hauck Mfg. Co., B'lyn, N. Y.
Buffalo Forge Co., Buffalo, N. Y.
Champion Blower & Forge Co., Lancaster, Pa.

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*Hauck Mfg. Co., B'klyn, N. Y.
*Mead-Morrison Mfg. Co., E. Boston.

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*Insley Mfg. Co., Indianapolis, Ind.
*M. & M. Wire Clamp Co., Minneapolis
Marion Mall. Iron Wks., Marion, Ind.
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*Blaw-Knox Co., Pittsburgh, Pa.
*Connery & Co., Phila., Pa.
*Heltzel Stl. Form & Ir. Co., Warren, O.
*Hotchkiss Stl. Products Co., Binghamton, N. Y.
*Lakewood Eng. Co., Cleveland, O.
*Raber & Lang Mfg. Co., Kendallville, Ind.
*Truscon Steel Co., Youngstown, O.
Concrete Form Co., Inc., Syracuse, N.Y.
Metal Forms Corp., Milwaukee.

FORMGRADERS
Edward G. Carr, Chicago.

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Casey-Hedges Co., Chattanooga, Tenn.
Jas. B. Clow & Sons, Chicago.
Crane Co., Chicago.
Murdock Mfg. & Sup. Co., Cincinnati.
Puro San. Dr. Ftn. Co., Haydenville, Mass.
Rundle-Spence Mfg. Co., Milwaukee.
Stewart Iron Wks. Co., Cincinnati, O.
Halsey W. Taylor Co., Warren, O.
20th Century Brass Wks., Belleville, Ill.

FURNITURE AND FILES, STEEL
Art Metal Const. Co., Jamestown, N.Y.
Gen. Fireproofing Co., Youngstown, O.
Van Dorn Ir. Wks. Co., Cleveland, O.

FURRING AND SLEEPER ANCHORS
Dayton Sure Grip & Shore Co., Dayton, O.

GARBAGE CANS (See Cans)

GARBAGE DISPOSAL
American Beccari Corp., N. Y.
Balmer Corp., N. Y.
C. O. Bartlett & Snow Co., Cleveland, O.
Decarie Incinerator Co., L. I. C., N. Y.
Goder Incinerator Corp., Chicago.
Hiler Eng. & Const. Co., B'klyn, N. Y.
Morse-Boulger Destructor Co., N. Y.
Nye Odorless Crematory Co., Macon, Ga.

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*Heil Co., Milwaukee, Wis.
*Watson Truck Corp., Canastota, N. Y.
Geo. H. Holzbog & Bro., Jeffersonville, Ind.
Lee Trailer & Body Co., Chicago.
Tiffin Wagon Co., Tiffin, O.

GAS METERS (See Meters, Gas)

GAS PRODUCERS
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.
R. D. Wood & Co., Phila., Pa.

GASOLINE STORAGE TANKS
*Heil Co., Milwaukee, Wis.
*Littleford Bros., Cincinnati, O.
Biggs Boiler Works, Akron, O.
Birmingham Tank Co., B'mingham, Ala.
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Chicago Bridge & Iron Wks., Chicago.
Graver Corp., E. Chicago, Ind.
Wm. B. Scaife & Sons, Pittsburgh, Pa.
Tokheim Oil Tank & Pump Co., Ft. Wayne, Ind.
United Iron Wks., Inc., K. City, Mo.
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Coffin Valve Co., Boston, Mass.
Coldwell-Wilcox Co., Newburgh, N. Y.
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Lunkenheimer Co., Cincinnati, O.
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J. D. Adams & Co., Indianapolis, Ind.
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HAMMERS, STEAM, PILE (See Pile Hammers, Steam)

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*Amer. Saw Mill Mchy. Co., Hackettstown, N. J.
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*Harnischfeger Corp., Milwaukee, Wis.
*Lidgerwood Manufacturing Co., N. Y.
*Mead-Morrison Mfg. Co., E. Boston.
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Weller Mfg. Co., Chicago.

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*Lakewood Eng. Co., Cleveland, O.
*Lidgerwood Mfg. Co., N. Y.
*Mead-Morrison Mfg. Co., E. Boston.
Pansome Conc. Mchy. Co., Dunellen, N.J.

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*Clyde Iron Wks. Sales Co., Duluth, Minn.
*Dobbie Fdry. & Mach. Co., Niagara Falls
*S. Flory Mfg. Co., Bangor, Pa.
*Harnischfeger Corp., Milwaukee.
*Lidgerwood Mfg. Co., N. Y.
*Mead-Morrison Mfg. Co., E. Boston.
*Mundy Sales Corp., N. Y.
*O K. Clutch & Mach. Co., Columbia., Pa.
*Street Bros. Mach. Wks., Chatta., Tenn.
*Vulcan Iron Wks., Wilkes-Barre, Pa.
Am. Hoist & Derrick Co., St. Paul, Minn.
Chrisholm-Moore Mfg. Co., Cleveland, O.
Ntl. Hoisting Eng. Co., Harrison, N. J.
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*Sullivan Mchy. Co., Chicago.
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Gilman Mfg. Co., E. Boston, Mass.
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Independent Pneum. Tool Co., Chicago.
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*Clyde Iron Wks. Sales Co., Duluth, Minn.
*Dake Eng. Co., Grand Haven, Mich.
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*S. Flory Mfg. Co., Bangor, Pa.
*Ingersoll-Rand Co., N. Y.
*Insley Mfg. Co., Indianapolis, Ind.
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Amer. Hoist & Derrick Co., St. Paul, Minn.
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*Lidgerwood Mfg. Co., N. Y.
*Superior Body Corp., Marion, Ind.
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Borg & Beck Co., Chicago
Detroit Trailer & Mach. Co., Detroit.
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Fabric Fire Hose Co., N. Y.
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Niagara Metal Stamping Corp., Niagara Falls, N. Y.

HOUSES, PORTABLE (See Buildings, Portable)

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Brunswick-Kroeschell Co., N. Brunswick, N. J.
Carbondale Mach. Co., Carbondale, Pa.
De La Vergne Mach. Co., N. Y.
Frick Co., Inc., Waynesboro, Pa.
Triumph Ice Mach. Co., Cincinnati, O.
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Vilter Mfg. Co., Milwaukee, Wis.
Henry Vogt Mach. Co., Louisville, Ky.
York Mfg. Co., York, Pa.

INCINERATORS, GARBAGE (See Garbage Disposal)

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*Conard & Buzby, Burlington, N. J.
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Gulick-Henderson Co., N. Y.
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Pittsburgh Testing Lab., Pittsburgh.
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JOINTS, FLEXIBLE PIPE (See Flexible Joints)

JOISTS, STEEL
*Truscon Steel Co., Youngstown, O.
Berger Mfg. Co., Canton, O.
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*Acme Rd. Mach. Co., Frankfort, N. Y.
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Birmingham Tank Co., Bmingham, Ala.
Chase & Lyman, Boston, Mass.
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R. E. Dietz Co., N. Y.
Handlan, Buck Mfg. Co., St. Louis.
Star Headlight & Lantern Co., Rochester, N. Y.

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Berger Mfg. Co., Canton, O.
Bostwick Steel Lath Co., Niles, O.
Gen. Fireproofing Co., Youngstown, O.
Milwaukee Corr. Co., Milwaukee, Wis.
Northwestern Exp. Metal Co., Chicago.
Penn. Metal Co., Boston, Mass.
Sykes Metal Lath & Roofing Co., Niles, O.
Youngstown Pressed Steel Co., Warren, O.

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Coldwell Lawn Mower Co., Newburgh, N.Y.
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Plymouth Loc. Wks., Plymouth, O.
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Clarksville Fdry. & Mach. Wks., Clarksville, Tenn.
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*Pittsburgh Meter Co., Pittsburgh, Pa.
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Ford Meter Box Co., Wabash, Ind.
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General Elec. Co., Schenectady, N. Y.
Sangamo Elec. Co., Springfield, Ill.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

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American Meter Co., N. Y.
Bailey Meter Co., Cleveland, O.
Builders Iron Fdry., Providence, R. I.
Cleveland Gas Meter Co., Cleveland, O.

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*Union Water Meter Co., Worcester, Mass.
Badger Meter Mfg. Co., Milwaukee.
Buffalo Meter Co., Buffalo, N. Y.
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Gamon Meter Co., Newark, N. J.
Hersey Mfg. Co., Boston, Mass.
National Meter Co., N. Y.
Thomson Meter Co., B'klyn, N. Y.
Worthington Pump & Mchy. Corp., N.Y.

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Builders Iron Fdry., Providence, R. I.
Simplex Valve & Meter Co., Phila., Pa.

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MIXERS, GROUT
*Am. Cem. Mchy. Co., Inc., Keokuk, Ia.
*Lakewood Eng. Co., Cleveland, O.
Kent Mach. Co., Kent, O.
Union Iron Wks., Inc., Hoboken, N. J.

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*Barber Asphalt Co., Phila., Pa.
*Koehring Co., Milwaukee, Wis.
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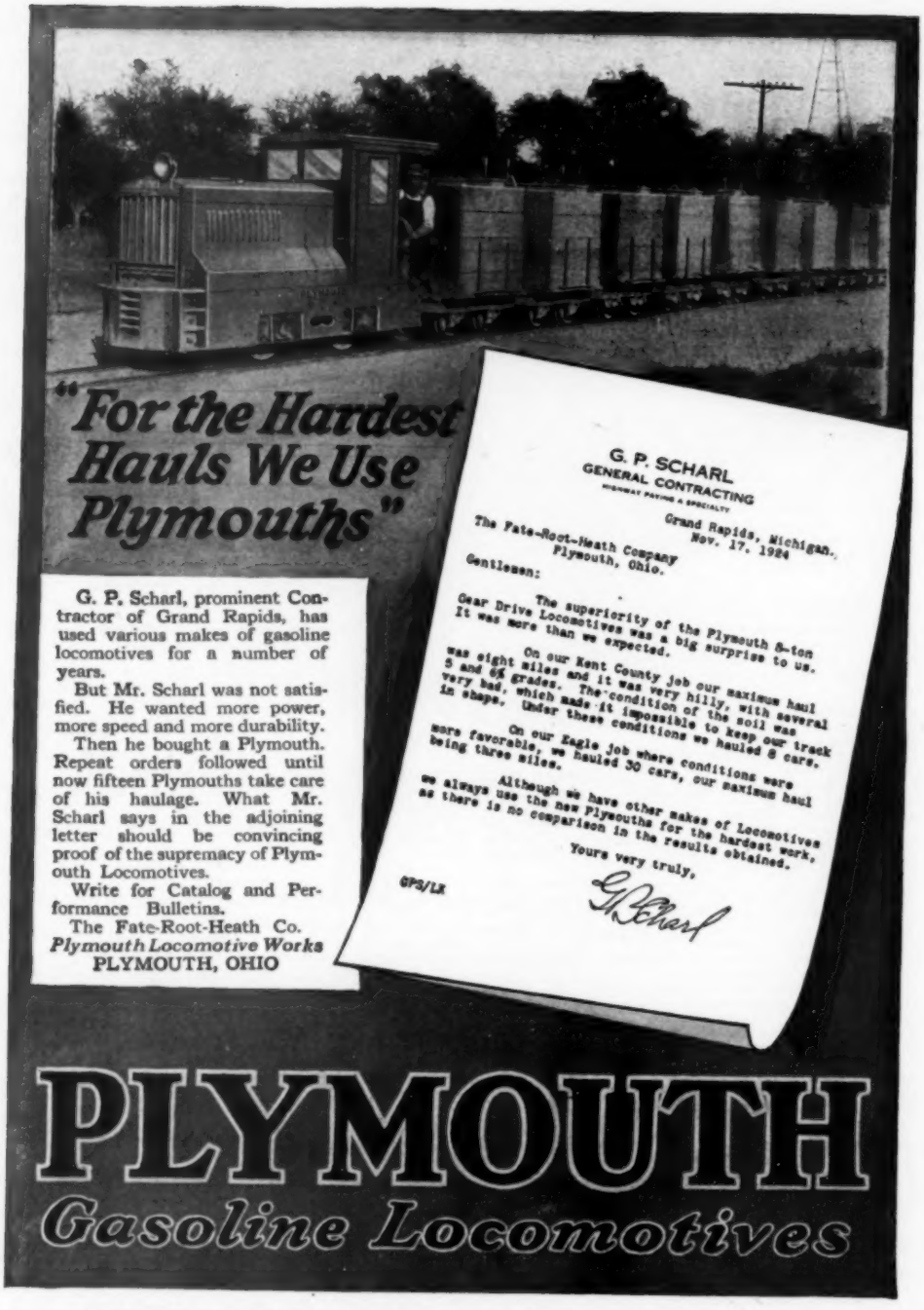
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G. P. SCHARL
GENERAL CONTRACTING
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Nov. 17, 1924
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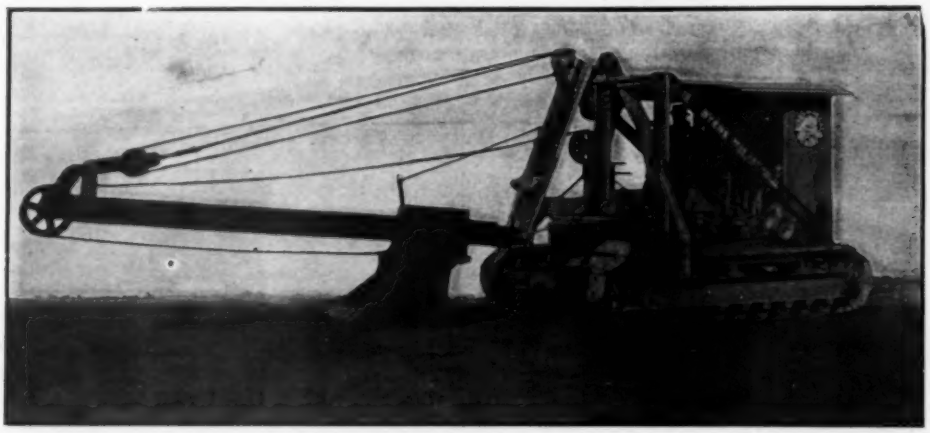

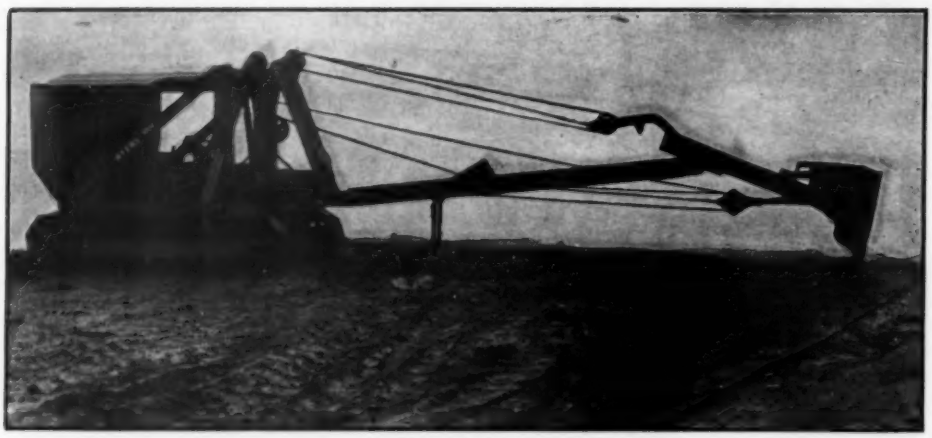

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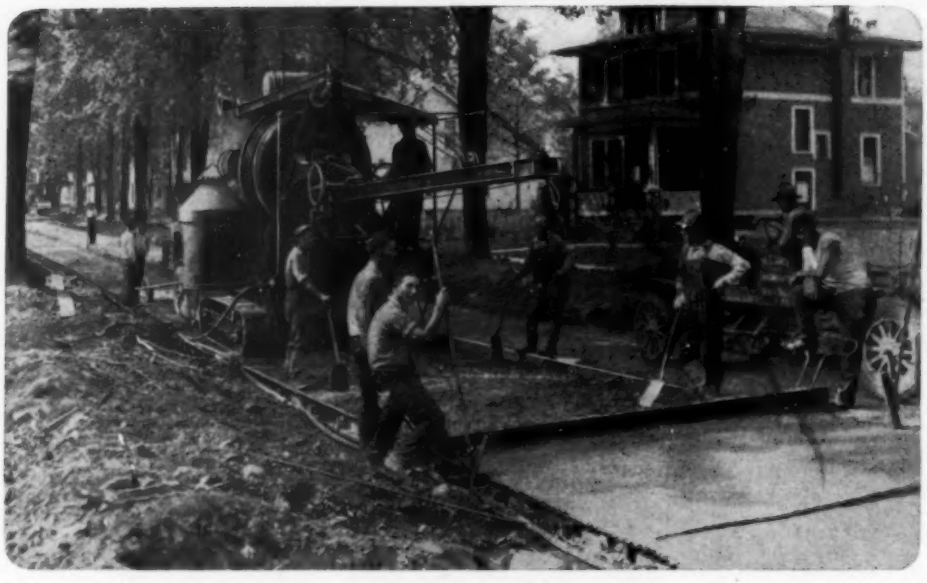

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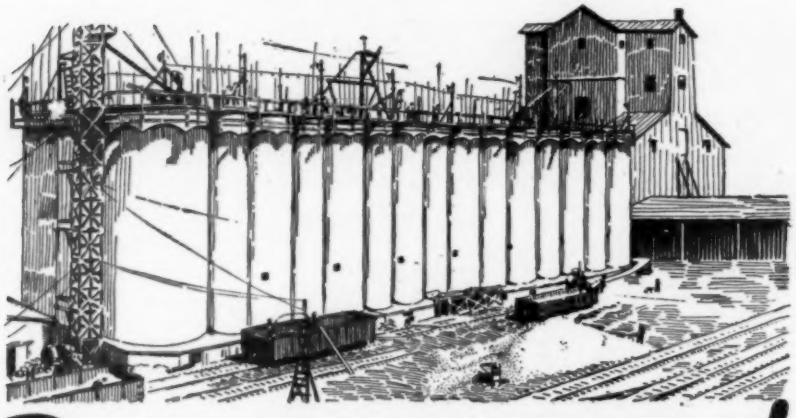

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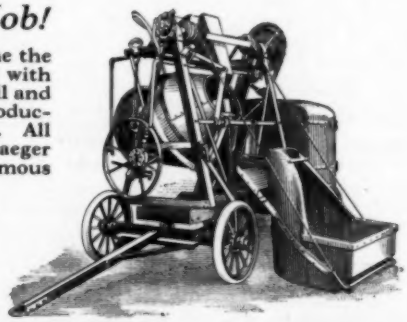

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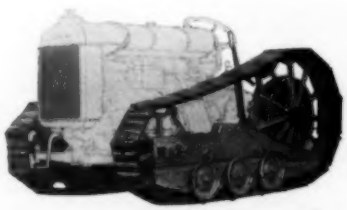

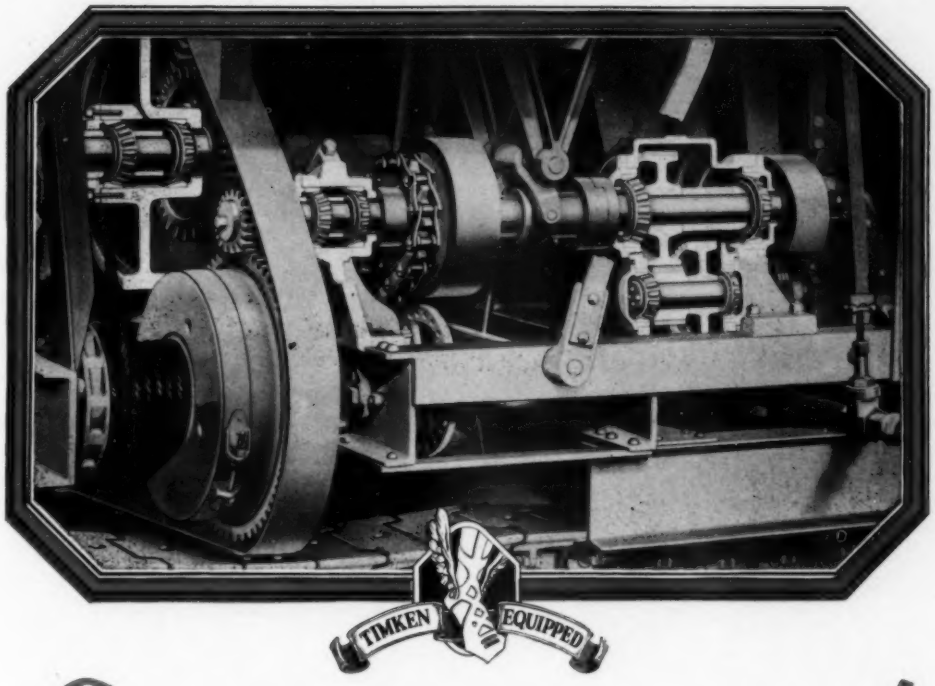

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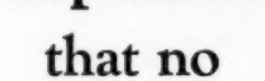

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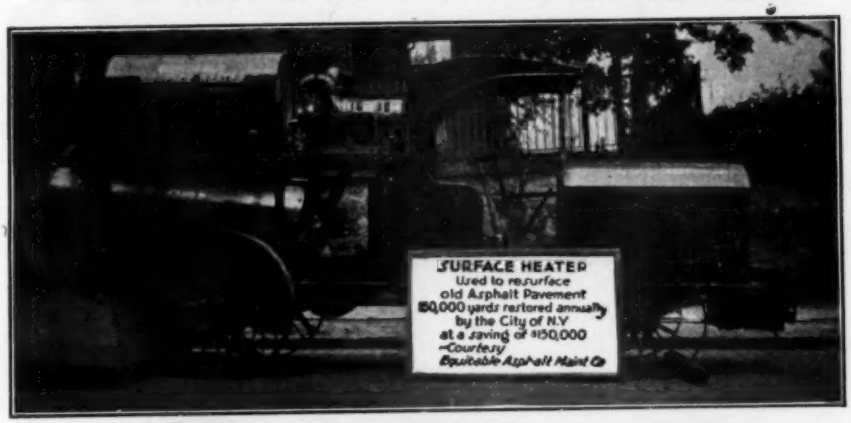

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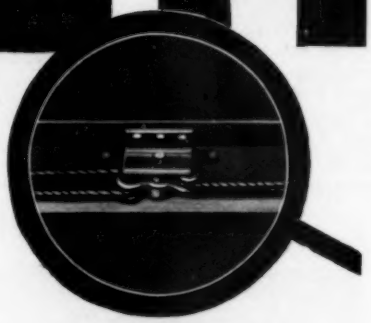

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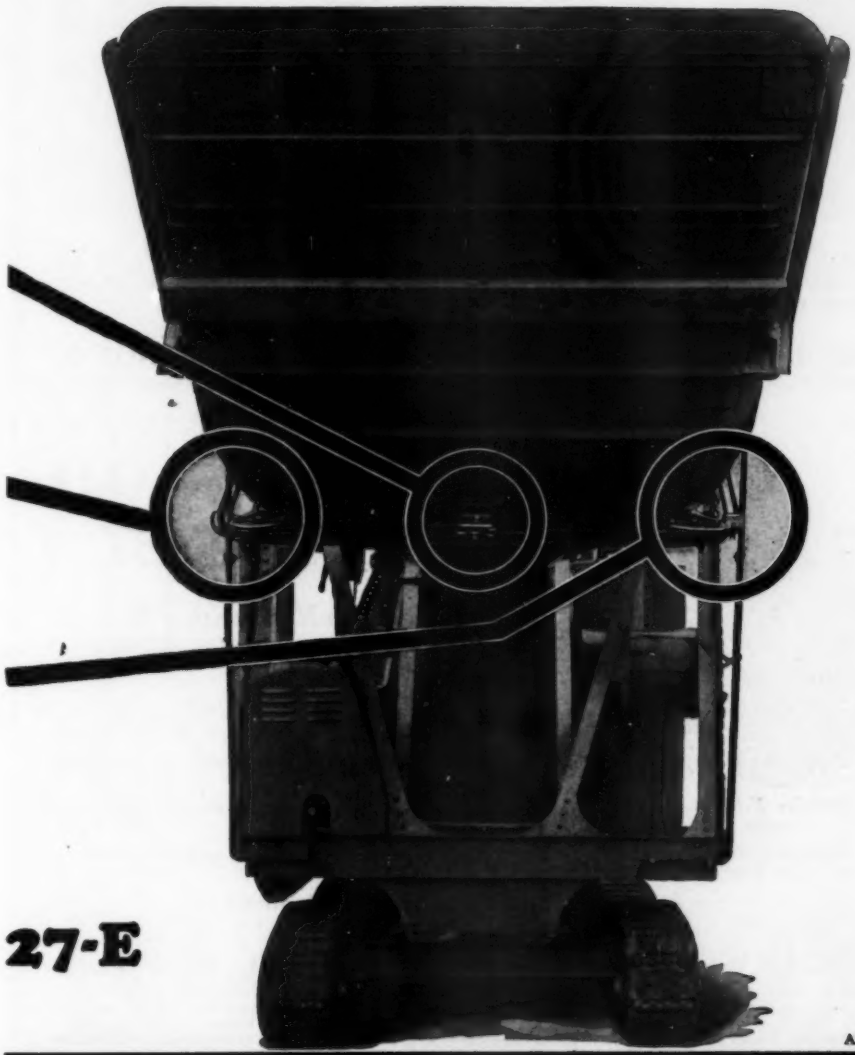

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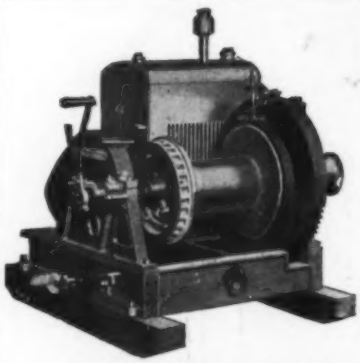

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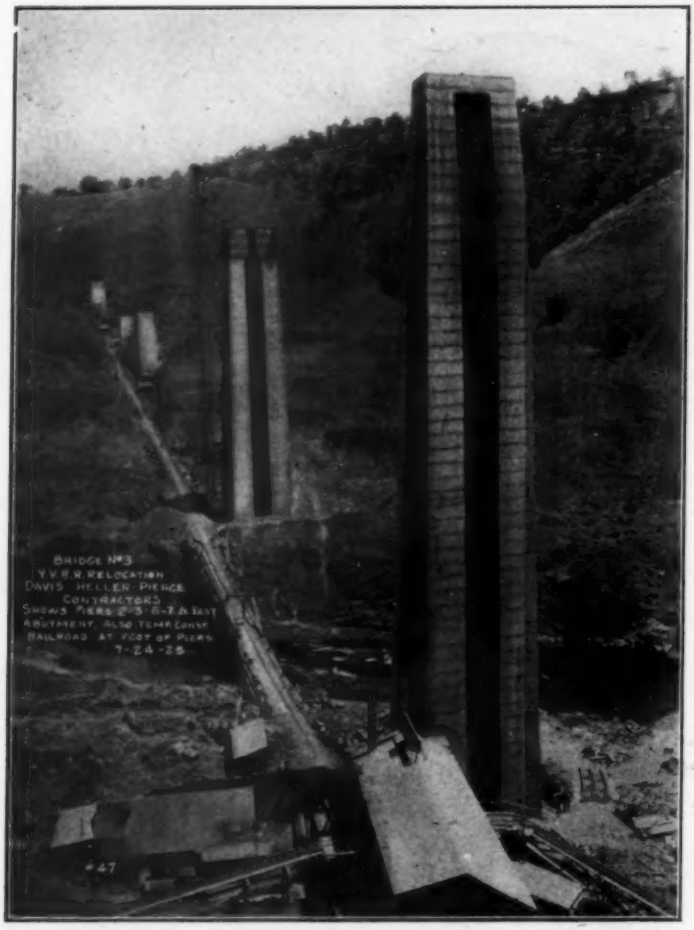
The Exchequer Project of the Merced Irrigation District

By Ross White
Resident Engineer, Merced Irrigation District

THE Exchequer Project of the Merced Irrigation District is now nearing completion. It is confidently expected that all units can be put into service early enough in the present season to allow the impounding of the snow-water run-off from the high Sierras.

EXCHEQUER DAM NEARING COMPLETION, JANUARY 21, 1926

Mixing-plant and hoisting-tower in foreground with temporary tunnel carrying main line of the Yosemite Valley Railroad in left foreground. Right foreground—power-house nearly completed except for roof. Portion of south spillway channel visible at extreme right



CONCRETE PIERS FOR RAILWAY BRIDGE UNDER CONSTRUCTION
Concreting plant and finished 228-foot pier in foreground. Incline railway crossing river channel, and other piers under construction, seen in background

While primarily an irrigation storage project, requiring a high masonry dam, the work includes the relocation of 17 miles of mountain railway, the construction of a long railroad bridge on the highest concrete piers ever used for this type of work, and the installation of a 42,000-h. p. hydroelectric plant.

Exchequer Dam is located in the canyon of the Merced River about 30 miles northeast of Merced, Calif. At the point selected for the dam, the canyon walls draw in, till they are less than 100 feet apart at the river level, and at the dam crest, 330 feet higher, have widened to only 900 feet. The rock through which the river has carved its way is an extremely hard blue diorite, entirely suitable as a foundation for a high masonry dam. Test borings 200 feet deep showed no indications of any change in the character of the rock. Ledge rock was exposed over practically the whole stream-bed, the only excavation required at that point being the removal of a few yards of gravel and boulders, and the construction of a cut-off trench at the up-stream toe. Considerable soil and decomposed rock had accumulated on the sides, however, and about 37,500 yards of material were removed from the dam foundations. At one point, where a particularly heavy deposit occurred, several thousand yards were loaded directly into Western dump-cars by an Erie steam shovel. With this exception, all foundation excavation was loaded by hand into skips, and handled by an Insley derrick and a Lidgerwood cableway to narrow-gage cars. Plymouth gasoline locomotives hauled these cars to dumps a short distance up-river, where the canyon widened somewhat.

Exchequer Dam is designed with a full

gravity section, and is also arched in plan on a radius of 675 feet. The maximum stress in concrete with reservoir full is 30 tons per square foot. A fairly complete field laboratory was maintained and daily tests made of the concrete as poured. Four sizes of aggregate were used: sand up to ¼-inch; fine gravel ¼-inch to 1¼-inch; coarse gravel 1¼-inch to 3-inch; and cobbles 3-inch to 10-inch. A carefully controlled mixture of these aggregates made possible the production of a concrete averaging above 1,600 pounds per square inch at 28 days with only about 0.8-barrel of cement per cubic yard. About 390,000 cubic yards of concrete were required, of which 360,000 were in the dam proper, 20,000 in the spillways, and 10,000 in the power-house.

The Merced River has a recorded maximum discharge of 37,500 second-feet. As authentic records go back only about twenty years, a spillway capacity of double this amount was assumed as necessary. This was provided by two overpour type spillways, one at each end of the dam. Each is 168 feet long and discharges into a concrete-lined channel which leads the water to the river about 100 feet below the dam. About 50,000 cubic yards of rock excavation was required for these spillways. Each spillway is provided with seven vertical butterfly type gates, 14 feet high by 24 feet wide, made by the Llewellyn Iron Works, Los Angeles, from designs of the District engineers. As the reservoir at this height covers nearly 3,000 acres, over 40,000 acre-feet of additional storage is obtained by the use of these gates. Full reservoir capacity is 280,000 acre-feet.

Facing a contract completion date only eighteen months away and the problem of handling 800,000 tons of material in that time, the contractor for the dam installed a plant and organization that functioned so well that 335,000 yards of concrete was poured in 335 operating days. This is all the more remarkable in view of the very limited space available for plant. The canyon is narrow and subject to heavy floods in winter, and is further occupied by the main line of the Yosemite Valley Railroad. This road is about 90 feet above river level, running directly through the dam site, and a traffic of 20 to 30 trains had to be cared for daily. Partly offsetting these disadvantages was the fact that the railroad was immediately available for shipping in plant and material. A large lumber mill is located only eight miles below the dam and served by the Yosemite Valley Railroad, so while equipment was en route from headquarters, lumber was obtained and a camp installed about one-fourth mile below the dam site. A cook-house, with a dining-room seating 400, and tent houses for the men, were first erected. Commissary, office, ice plant, and two- or three-room shacks for married foremen and engineers, came later. The maximum number of men working and cared for at any one time was about 500.

PLACING 110-FOOT PLATE GIRDERS FOR BRIDGE NO. 5 ON THE YOSEMITE VALLEY RAILROAD RELOCATION

The highest piers in this bridge are over 100 feet. Individual girders weigh 43 tons each. The rugged country through which the relocated line runs is shown in the background

Aggregate

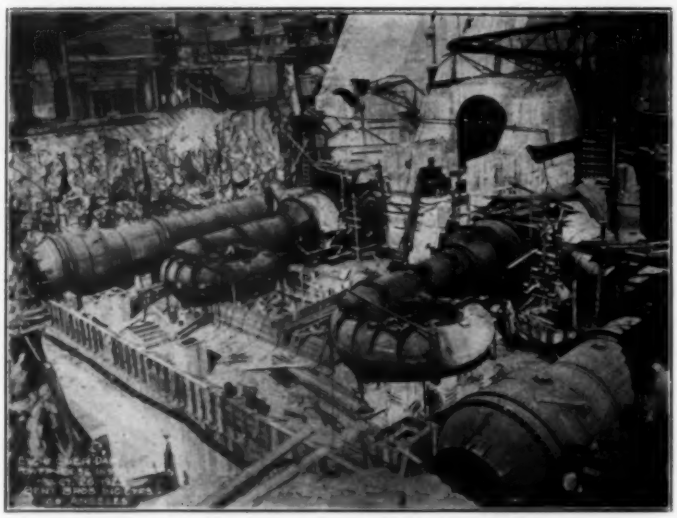
A gravel bar 17 miles below the dam was selected as the source for concrete aggregates.

Spur tracks were built to this bar, and a modern screening and washing plant with a capacity of 5,000 tons per day was installed. Under the terms of the contract, this plant was required to furnish concrete aggregates and ballast for the railroad work, as well as for the dam. Gravel was excavated by two draglines, a Monighan of 2½-yard capacity, and a P. & H. with a 1-yard bucket. As the composition of the bar varied at different locations, the use of two machines not only made for flexibility and dependability, but enabled the plant output to be varied as needed on different structures. Material was shipped from gravel plant to dam in standard hopper-bottom cars of 30-yard capacity, a train usually consisting of eighteen cars.

Owing to space limitations, only about 1,000 yards of storage was provided in bunkers at the dam. These bunkers fed directly into "aggrameters" or adjustable batch-measuring hoppers, which in turn discharged into 3-yard Insley narrow-gage cars. Each car held a measured charge for the mixers. Gasoline locomotives hauled the loaded cars to the mixer house, where they were dumped directly into the mixers. The mixing plant consisted of three 2-yard Smith tilting mixers. Ordinarily, only two mixers were in use, the third being held for emergencies or for special mixes. The cement house was directly above the mixers. Cement was dumped on this floor, and led in a closed chute to the mixers. By far the greater part of the cement used was handled directly from car to mixer, only enough being held in storage to tide over inequalities in delivery.

Insley chutes carried the mixed concrete to a hopper at the base of a two-compartment steel tower. Each compartment of the tower carried a bucket of 2-yard capacity. The tower was first erected to a height of 350 feet, but, as the dam became higher, was extended to a height of 470 feet. This is believed to be a record height for equipment of this character. The tower was equipped with a movable boom chute line, and also had two double-counterweight chute lines suspended from cables spanning the canyon. This plant gives a high degree of flexibility and has given very satisfactory service.

Two cableways are in use on the job. One is a Lidgerwood standard high-speed machine of 10-ton capacity and 1,200-foot span, used for excavation, handling machinery, setting and moving derricks, etc. The other is "home-made," of 3-ton capacity, and is used principally for shifting chute lines and for work in erecting and dismantling the high tower.



EXCHEQUER POWER-HOUSE UNDER CONSTRUCTION
Two turbine scroll cases, penstock regulator valve, and 96-inch needle type free discharge valve before being imbedded in concrete

As is usual in jobs of this size in isolated location, a complete machine shop, blacksmith shop, and wood working shop is maintained. A large amount of the smaller equipment used has been made on the job. The development of acetylene cutting and welding has made it possible to do much work in the field which formerly could be done only in a well-equipped permanent shop.

As the speed and economy of concreting is largely dependent on the form work, much thought was given to the type of form to be used. A wood panel, 5 feet high and 8 feet long, was finally selected, and has proved entirely satisfactory. With careful handling and

DOWN-STREAM FACE OF EXCHEQUER DAM

Power-house with one scroll case and 96-inch by-pass seen in immediate foreground. Above this is the temporary diversion flume with permanent spillway immediately above

PLACING CONCRETE IN EXCHEQUER DAM DURING EARLY STAGES OF CONSTRUCTION
Streams of concrete can be seen pouring from two counterweight chutes. The upper end of the 96-inch penstocks and the forms for inspection galleries are also shown in this view. The old line of the Yosemite Valley Railroad is shown in the background

cleaning, these panels can be re-used almost indefinitely. Tie wire is No. 9 annealed, doubled, and twisted. One pair of wires is used for each 8 square feet of form surface. Form braces or spreaders are pieces of 1-inch pipe, which are pulled out as the fresh concrete is poured.

The work of building the power-house was included in the dam contract, as the power-house structure is an integral part of the dam. It is a reinforced concrete building, about 70 feet by 100 feet in plan, and 90 feet high from bottom of draft tubes to roof. It is located directly in the river channel, abutting against the dam. The principal items of equipment are two Pelton vertical variable-head turbines of 21,000 horse-power each, direct-connected to Westinghouse vertical generators of the same capacity; two 96-inch needle-type by-pass valves, made by Wm. Cramp & Sons Company, Philadelphia, for the Pelton Water Wheel Company; two 96-inch needle-type Wellman-Seaver-Morgan turbine regulating valves; and two 72 x 96-inch emergency slide valves, made in Los Angeles from District designs. The turbines are each fed by a 96-inch diameter penstock imbedded in the dam concrete. A wye-branch is provided on each penstock, to enable irrigation water to be by-passed around the turbines. Not directly in the power-house, but auxiliary to it, are two 60-inch sluice pipes, each controlled by a 48-inch x 60-inch slide valve and a 60-inch free discharge needle-type valve. The yearly output of the plant is estimated at 120,000,000 kilowatt-hours. This power has been sold under long-term contract to the public utility company serving this territory.

The greatest obstacle to the construction of Exchequer Dam was the existence, in and through the dam and reservoir site, of the Yosemite Valley Railroad. This is a standard-gage line about 80 miles long, running from Merced to the Yosemite Valley. It carries a considerable tourist travel and also serves the large lumber interests in the higher mountains. As the line followed the river for the entire distance, at an elevation only slightly above high water, it was evident that it must be moved before any storage project on the river was possible. The country on both sides of the river was known to be difficult, but survey parties were sent out, and finally, by relocating 17 miles of the line, the requirements of the railroad company were met. The relocated line has maximum grades of 1 per cent, compensated, and maximum curvature of 12 degrees. Over a million and a half yards of excavation were required, a large part of which classified as rock. Four tunnels were driven, totaling 3,700 feet in length, all requiring heavy timbering and complete lining with concrete. Two timber trestles and five steel bridges completed the major construction items.

The railroad grading had no unusual features beyond the necessity of protecting traffic on the old line. For long distances, the new railroad paralleled the old, but 100 or more feet above it, and not that far away horizontally. Prohibitive penalties were incurred if traffic was blocked, so extraordinary precautions had to be taken in blasting and shovel operation. Flagmen were always on duty to stop trains if a stray boulder had lodged on the track or broken a rail. Work had to be entirely suspended as trains actually passed.

Tunnels were excavated by the heading and bench method. Wall plates and roof segments were set as the heading advanced, and the side posts were set after every round on the bench. Tunnel No. 1, 600 feet long, was done under subcontract, mucking being done by hand. Mucking in all other tunnels was done by Erie air-operated ½-yard revolving shovels, with special short cab and boom.

All tunnels were concrete-lined, leaving the timbering in place, timbers being set so that the concrete had a minimum thickness of 12 inches in front of posts and below roof segments. Not much side lagging was used, but where it was necessary, enough was always removed so that the space back of posts and lagging was solidly filled with concrete.

Except on two curves, steel forms were used in the tunnels. A footing course was poured first, and in it were imbedded bolts to hold the main form. Sides and arch were in one piece, hinged at the springing line. To move forms, a timber jumbo 20 feet long, running on rails set near the side, was run under the panel to be moved. Jacks on top of the jumbo took the weight of the form, and the bolts in the footing course were loosened and the sides pried out sufficiently for clearance. Screwing down the jacks then gave arch clearance, and the jumbo was moved forward to the new location. There, the panel was jacked up to proper height, the sides attached to the bolts previously set, and the panel was again ready for use. The steel forms and the scheme for moving and setting have proved very satisfactory.

Tunnel concrete was all mixed at plants established at the portals and hauled into the tunnels by narrow-gage gasoline locomotives. With the exception of a small amount placed by hand shoveling, all concrete was placed in the forms by the use of the Hackley concrete gun. This consists essentially of a horizontal steel cylinder, into which a batch of concrete is dumped. Air-tight bulkheads are then fastened, compressed air turned into the cylinder, and the concrete is forced out, through a 6-inch pipe, to any position desired. The gun and placing pipe were carried on a movable jumbo, running on rails used for the form jumbo, so that the outfit could readily follow the advancing lining. This type of equipment is patented, and has been used on several recent tunnel lining jobs. It shows decided advantages in speed and cost over methods previously used in lining work.

Of the five steel bridges required, all fabricated at the Gary plant of the American Bridge Company, four are deck plate girder spans crossing gulches running into the main river. All rest on concrete piers, some of the piers being over 100 feet in height. On three of the bridges, girders 110 feet long are used. This span approaches the maximum ever used, but was justified on account of the great height of piers needed. All bridges are designed for Cooper's E-50 loading.

The fifth bridge carries the relocated line across the river canyon at a point about seven miles above the dam. The total length of the bridge is 1,580 feet, made up of four 80-foot plate girders and four 315-foot truss spans. The maximum depth of water with full reservoir is 220 feet, and the distance from base of rail to river-bed is 245 feet. As the railroad company specified that no reinforced concrete be used under high-water level, a design calling for a "dumb-bell" shaped pier was selected. The top of the highest pier is 228 feet above

GENERAL VIEW OF CAMP AND BRIDGE NO. 5 OF YOSEMITE VALLEY RAILROAD RELOCATION AS COMPLETED EXCEPT FOR PAINT

The old and new lines can both be seen in the background, with the new line some 100 feet above the old, on precipitous slopes

foundation and 214 feet above ground level. Two other piers exceed 200 feet in height. This is believed to be a record height for piers on a railroad bridge.

Extraordinary care was used to get the highest quality of material and workmanship in these piers. Not only was tested cement used, but daily tests were made of the aggregates and of the mixed concrete; 28-day tests on concrete cylinders show an average strength of over 2,500 pounds per square inch.

The contractor's plant for this job consisted of two Leach-Oshkosh 1-yard mixers, two Insley steel hoist towers, and a cableway and incline railway for distributing the concrete. Aggregates and cement came in over the old railway line. Cement was unloaded directly into the mixing plant, one floor above the mixers. Aggregates were dumped into bunkers and measured out into side-dump cars, which were pulled up an incline to the mixer. The "inundation" method of measuring sand was used, and the water content of the mixed concrete very carefully controlled.

Owing to the great height and the danger from floods, the truss spans are being erected by the cantilever method. There are ten panels per span. On the first span, a false bent was used at the second and fourth panel points; on all others, one false bent only is used, located at the fourth panel point.

The work is now so near completion that feature costs are known quite closely. Exclusive of rights of way, financing, engineering, and office overhead they are as follows:

Exchequer Dam	$3,270,000
Exchequer Power-Plant	930,000
Relocation of 17 miles of Yosemite Valley Railroad (exclusive of bridges)	3,050,000
Five railroad bridges	1,520,000

Bent Brothers, Incorporated, Los Angeles, for whom M. H. Slocum is Superintendent, are contractors for Exchequer Dam and Power House. F. Rolandi, San Francisco, has the contract for all railroad grading and tunnel work. Davis-Heller-Pearce Company of Stockton did all excavation and concrete work for the railroad bridges, and the U. S. Steel Products Company is fabricating and erecting the steel work. Jerome Newman is Consulting Engineer for the Yosemite Valley Railroad on all the railroad work. For the Merced Irrigation District, R. V. Meikle is Chief Engineer, A. J. Wiley, Consulting Engineer, and Ross White, Resident Engineer.

Good-Will Determines Credit

"THE good-will of a business is a determining factor in the amount of credit which that business can secure," according to William B. Bamburgh, Public Relations Counsel, speaking at a luncheon of the Credit Association of the Building Trades of New York.

"Credit," said Mr. Bamburgh, "is insecure when it does not consider the basic foundations upon which good-will exists. Good-will cannot exist unless the facts of personal and corporate action are known to the public.

"The principles which dominate the purchasing agent and his actions are as important in building up credit for a given concern as are the actions of the sales manager, president, or treasurer. Into the product which the company creates is fused the character of the people who are concerned in the production."

Five Contractors Default

ON $80,000,000 worth of school building carried on through fifteen years in Chicago only five contracts have been defaulted. These defaults cost surety companies a total of $100,000. The total number of premiums the companies collected was $1,200,000.

These statements were brought out at a recent meeting of the Chicago Board of Education. An intensive investigation has been carried on by the business manager of the Board, and this investigation brought out the fact of the unnecessary drain on the building fund for surety bonds. The practice of using surety bonds has been looked into and the above figures are from a report made to the committee. A plan has been suggested whereby the surety bond will be eliminated. This plan will cost an estimated $7,250 a year in place of the slightly less than $100,000 annually paid out heretofore to bonding companies. The expenditures under the new plan will be $4,800 to go to a real estate accountant, $1,500 to a stenographer, $900 for automobile maintenance, and $50 for premium of a $20,000 bond covering the accountant.

The question is, is Chicago's case an isolated one? If not, we have a situation in this country for public school building alone which means a waste of millions of dollars. Here is a subject for investigation for every contractor who is interested in school building construction, and every other contractor for that matter, because all contractors help pay the taxes for school construction and all contractors are interested in seeing the costs of construction rid of waste.

And, of course, the wider significance of this finding of the Chicago School Board lies in its application to all construction work. The price paid for bonding contractors runs into a very tidy little sum when we consider the seven billion dollars of construction in the United States.—*The American Contractor.*

Comparative Costs for Winter Construction

Material Increase in Number of Contracts for Winter Work with No Increase in Costs

AT a recent meeting of the Architectural League, Thomas C. Desmond, President of T. C. Desmond & Company, engineers and contractors, illustrated by an analysis of costs of two winter construction jobs recently completed by his company the economies of building in unseasonable periods. The Park-Lexington Building, a 20-story office building, and the Sunnyside Long Island development of one- and two-family brick houses, showed no increased cost by winter construction.

Mr. Desmond said that the present seasonal variations in construction work with halting of construction work during the winter and consequent unemployment of building trades mechanics and other resulting building-trade evils, are almost entirely unnecessary, and are unjustified from any standpoint except the blind following of tradition. The building business has many traditions, not all of them worthy of being followed. Winter construction has been proved entirely practicable in all cases of engineering and building construction work where competent architects, engineers, and general contractors are in charge who take the obviously required precautions against very cold weather and carry on the work in accordance with recognized principles of good practice.

Subcontractors and material dealers are willing to furnish their services and materials on winter jobs with less allowance for overhead charges and profits than on summer jobs. The reason for this is the desire to keep their organizations intact and reasonably busy during the winter. This results in economy to the owner and the general contractor.

In some trades, such as the painting and decorating trades, subcontractors will take jobs during the winter for at least 10 per cent less than similar jobs during the summer. Savings on such contract purchases generally offset the increased cost of masonry and other items adversely affected by cold weather.

If architects and engineers really understand what an advantage it is to call for bids when contractors and material-men are hunting for business, as they all are late in the fall and early in the winter, more jobs would be started than at the customary time in March and April. Low bids can be obtained from excavating contractors, for instance, much more easily in November and December, when their steam shovels and other equipment are generally idle, than in April and May. On the Park-Lexington Building and the Sunnyside development, jobs widely divergent in character, Mr. Desmond said, the same principles of advantageous winter construction prevailed, and neither of the operations cost any more, considering the important savings in subcontracts and material purchases effected, than if they had been built during the summer.

The experience of T. C. Desmond & Company in successfully carrying on winter construction on the Sunnyside one- and two-family brick houses at no greater cost than ordinary summer costs was particularly important because of the general and yet erroneous belief throughout the country that this vitally necessary medium-priced housing work must necessarily stop during the winter even if very large buildings can be erected then. One more old and ignorant tradition exploded! Such ordinary house building does not have to stop during the winter for any good reason in any state, except in possibly the coldest northwestern states, and most assuredly it is possible to continue small-house construction during the winter in New York State.

At one of the recent regular meetings of the New York Society of Architects, G. Richard Davis, builder, explained the methods used by his company in winter construction. He said that there are practical ways of doing the work which will facilitate the final result of the construction. Last winter on a steel and reinforced cinder concrete type of construction in New York, he proceeded without loss of a single working day. There were days when some of the trades could not work, but the chief trouble lay in the transportation through the streets when they were blocked with snow and ice. Owing to the necessity for completion at a certain date, when his company took the job, they arranged to deliver material in advance and planned spaces where they could store it as a source of supply for bad days.

How Thoroughly Do You Investigate Jobs Before Bidding?

By N. F. Helmers

Siems, Helmers and Schaffner, Inc., Contractors, St. Paul, Minn.

IN a general way, the investigation of highway projects on which a contractor is intending to bid may be grouped under two headings, financial and physical. Under the first heading the contractor should ask the following questions: Are funds available now? Will payments be made monthly? What is the retained percentage? If cash is not available, what are the arrangements made, and are they sound? Are they legal in every detail?

Under investigations of a physical nature, there are many more items to be considered: character of soil (if the bid is on various classifications, the engineer's interpretation should be ascertained on the ground, if possible); weather conditions of the country; railroad facilities to the site; available spur track; desirability and expense of additional trackage; existing roads and cost of maintenance; cost of additional roads; sources of fuel and water; housing of men and camp locations; local labor rates; the production of pavement aggregate locally (it is always safer and therefore good business to have enough money in the bid price to cover the purchase of such aggregate from a responsible material-man, for test pits are often deceptive as to final results); and then, first and last, study the plans and specifications. It is always safest to assume that they mean everything they say. Put a money value on every unfair joker you find.

Too many jobs, even very large ones, have been bid in either without any inspection or at least without real detailed inspection by those financially interested in the outcome. Any job that is to be bid must be considered in the light of a contract secured. A bidder should have in his mind the way to lay out and handle that particular job. If successful, he may modify or entirely change that way, but unless he bids with a feasible method of procedure in mind, that bid is not an intelligent proposal.

The greatest fault with bidding to-day seems to be the mob psychology which causes contractors to rush to lettings, setting up in their thought a price which some dreaded competitor may bid and making their own prices below this assumption or guess, regardless of what careful figuring may have shown to be a proper price. There never was a time when any contractor needed a job so badly that he could afford to take or risk a serious loss in order to get it.

Contrasting with Manufacturer and Merchant

The contractor and the merchant or manufacturer work in different spheres. The manufacturer of to-day, generally speaking, because of the permanent nature of his business, knows his costs when he makes his selling price. Adverse market conditions may make it necessary for him to waive his overhead, which is a real part of his cost, or even to take a real operating loss in order to stimulate the market or drive out competition. He protects himself by only quoting from day to day, makes no long-time contracts, and retrieves on a rising market. He generally produces under his own specifications and his inspections. In other words, he stipulates what he sells for a price.

The nature of the construction contract is quite different. The work at hand, if of any magnitude, extends into the future for months, if not for a year or more. The rising market, which is a boon to the manufacturer, spells additional risk and possible loss to the contractor, and his price must also include protection for this. Furthermore, the construction business is practically the only one where the business man puts a price on something he has not produced and agrees to let another be the judge of the quality and quantity of what he produces. Unfair technicalities on the part of the engineer or the engineer's inspection board may greatly increase his cost and those obtained under fair treatment with no real difference in the results.

What Comprises the Total Bid?

Personally, I believe one of the inherent troubles of contracting to-day to be the lack of realization of, or at least a willingness to, consider the fact that a total bid must include three things, not two, namely, normal cost, contingencies, and profit or payment for services.

A contract is, besides proper performance of work, the underwriting of the cost to the

owner. The bond companies, who claim they are losing money on construction contract bonds, charge 1½ per cent for this privilege and their theoretical responsibility does not come into play until the contractor's entire assets are dissipated, and we all know of numerous cases where such responsibility has been entirely evaded through various technicalities. In fact, I am constrained to believe to a large degree that there is only one party to a contract who can be made to do anything, and that is the general contractor.

Labor troubles, defaulting subcontractors, unforeseen contingencies, embargoes, bad or unseasonable weather, indirect damage through delays and changes often desired by owners, the personal equation of the architect and engineers, all have their bearings on the final cost. Where do these items appear on your estimate sheet?

I appreciate that I am open to the usual criticisms that any one who adheres to the lines laid out above will never get a job. Why get a job if it does not promise a real or assured profit? The handwriting on the wall says that the railways, the highway department, and many other owners are tired of the delays, the incessant scrapping and pleading that go hand in hand with the unprofitable contract. This is the answer.

ACKNOWLEDGMENT.—From a paper read before the American Road Builders' Association, Chicago, 1926.

Convertible Excavator Removes Concrete Slabs

Outfit Equipped with Skimmer Scoop Used by Di Pillo and Balistreri at Barton, N. Y.

ON a 4.8-mile reconstruction job at Barton, N. Y., Di Pillo and Balistreri, contractors, of Geneva, N. Y., bid on the removal of concrete and macadam surface from the road preparatory to repaving with concrete. One-half of the pavement was concrete and the other half tar macadam with no subbase.

In handling the removal of the concrete, the skimmer bucket was thrust under the edge of a slab, and the boom was raised. After the slabs of concrete were worked up to a vertical position, the machine was propelled forward on its crawler mounting, tipping the huge slabs of concrete over so that they broke up into small pieces as a result of their own weight when striking the hard pavement ahead. The slab shown in the illustration is 6 inches thick, 9 feet wide, and approximately 12 feet high. The entire job was handled by the Bay City Model 16-B ¾-yard convertible excavator without preliminary chipping or shattering of the concrete. In all, about 4,000 feet was broken up as described above.

BAY CITY EXCAVATOR READY TO THROW A CONCRETE SLAB

Based on the experience of this job, it is estimated that one of these machines can load from 80 to 100 feet per hour, or from 800 to 1,000 feet per day, operating on one side of the pavement, where it is entirely straight-ahead work and no time is lost in shifting from one side of the pavement to the other.

Autocar Reorganizes

REORGANIZATION of the Autocar Company of Ardmore, Pa., is now under way. It will include an issue of non-voting stock with provisions in the by-laws regarding the issue which will meet the requirements of the New York Stock Exchange. If the plans materialize, it will be the first attempt of any corporation to issue non-voting stock since agitation against it started several months ago.

It is expected that the contemplated sale of securities will realize sufficient funds to pay off the funded debts and provide additional working capital to take care of the company's increasing volume of business.

Motion Pictures on Asphalt Paving for Loan

ANY responsible organization, club, or educational institution desiring to secure the loan of motion pictures showing the most modern methods of constructing sheet asphalt or asphalt macadam pavements may do so by writing to the Texas Company, Asphalt Sales Department, 17 Battery Place, New York. In writing, several dates should be chosen at which either or both of the films are desired.

The asphalt macadam film consists of one reel which can be shown in 15 to 20 minutes; the other consists of two reels and requires from 30 to 40 minutes. Both give a clear and comprehensive idea of the types of paving work treated.

Miscellaneous Notes

New Climax Distributors

THE Climax Engineering Company, Clinton, Iowa, has announced the appointment of the Briggs-Weaver Company, Dallas, Texas, as its District Representative.

American Institute of Steel Construction Moves Offices

THE American Institute of Steel Construction, Inc., has announced the removal of its executive offices to 285 Madison Avenue, New York.

Waukesha Official to Officiate at Races

CHESTER S. RICKER, Director of Advertising and Consulting Engineer with the Waukesha Motor Company, Waukesha, Wis., acted as Director of Timing of Scoring for the first race on February 22 on the new board automobile speedway at Fulford, Miami, Fla. For fourteen years Mr. Ricker has had charge of this department at the Indianapolis Motor Speedway and for five years has directed all the major events of the National Power Boat Association and National Aeronautical Association so far as the timing and scoring is concerned.

Barber to Manufacture Non-Corrosive Alloy

THE Barber-Asphalt Company, Philadelphia, Pa., has announced that it has taken over the exclusive rights to manufacture "Aterite," a non-corrosive, acid-resisting metallic alloy formerly made by the Aterite Company, Inc., John and William Streets, New York City. The Barber-Asphalt Company is now in a position to furnish Aterite valves, fittings and special castings to those requiring such a metal. These products will be manufactured at the Iroquois plant of the company, located in Buffalo, N. Y.

Aterite, although exceedingly ductile, has great strength and weighs 536 pounds per cubic foot, or approximately 19 per cent more than cast iron. A microscopic examination of the alloy shows it to be dense and homogeneous, with a close grain of smooth, uniform texture.

This alloy starts to fuse at 1541° Centigrade (2805° Fahrenheit) while its pouring temperature is 1690° Centigrade (3075° Fahrenheit). Aterite can be cast in any of the usual forms used in iron, brass, or other special alloys, and can also be cast in forms having thin walls, as the castings are remarkably free from blow-holes, cavities, and other surface or interior defects.

Aterite possesses excellent machining and working qualities, it cuts with remarkable smoothness, machines very easily, and when polished takes on a silver finish. This last-named property suggests its use for many articles which require a nickel plating.

Aterite is a patented product. It has found wide acceptance in the process industries and is recommended for use with many acids and bases.

Celite Moves San Francisco Office

THE Celite Products Co., 1320 South Hope Street, Los Angeles, Calif., has announced the removal of its San Francisco office from the Monadnock Building to 140 Spear Street, San Francisco, in order to provide larger quarters and better operating facilities.

Koehring Becomes President of Association of Commerce

P. A. KOEHRING, the well-known General Manager and Secretary-Treasurer of the Koehring Company, Milwaukee, Wis., was recently unanimously elected President of the Milwaukee Association of Commerce in recognition of his ability and his interest in the work of the Association.

Curd Made Distributor for Caterpillar Tractor

THE George B. Curd Equipment Company, 609-611 Reading Road, Cincinnati, Ohio, has been appointed distributor for the Caterpillar Tractor Company, San Leandro, Calif., in the entire state of Ohio. George B. Curd, President of the company, states that offices will be maintained in Cincinnati, Portsmouth, Dayton, Columbus, Toledo, and Cleveland.

The territory formerly served by the George B. Curd Equipment Company in Kentucky and the fourteen counties in southern Indiana which they also covered are being given up under the new contract.

Borchert-Ingersoll Made Sullivan Distributor

THE Sullivan Machinery Company, 162 South Michigan Avenue, Chicago, Ill., has announced the appointment of Borchert-Ingersoll, Inc., 2360 University Avenue, St. Paul, Minn., as its local distributors in the Twin Cities for Sullivan portable and stationary air-compressors, rotator hammer drills, Buster concrete breakers, clay spaders, Turbinair and electric portable hoists, as well as for Sullivan contractors' drill sharpeners. This equipment, and repairs for the different machines, will be carried in stock in St. Paul for the convenience of contractors in Minnesota, which is the territory assigned to the new distributors.

The Borchert-Ingersoll Company will work closely with the Sullivan branch office in Duluth, in the Alworth Building. J. A. Noyes is Manager of the Duluth Office.

Bowden Establishes Agency

GEORGE T. BOWDEN, formerly with T. H. Ball & Staff, is now established at Room 201, 6007 Euclid Avenue, Cleveland, Ohio, where he has his own agency to handle trade paper advertising.

Building Good-Will While Building

By James S. Frear

WORKING capital may be the life-belt that keeps a business afloat when its earnings are suffering from cramps or while it is learning to swim, but it's good-will that makes the commercial sea the business floats on. That being true, the component parts of the sea should bear an important relationship to every industry. Let's apply it to contracting.

Good-will is built in but two ways—service and education. The first is so frequently talked about that we will let it pass for this time. It is upon the second that a little time need be spent, in order that we may glean, here and there, an idea that may be applied to our business—to the growth of its good-will.

The educative process has two channels of outlet—the employee and the client. If one is to be approached with any degree of certainty and value, the other must be brought into its highest possible state. The employee, being the class most easily approached, is also the one that should be the recipient of the first educative effort. On his elevated status the client may be approached, with confidence that the effort will not be lost.

The premise should first be established that the industry holds itself responsible for those educational activities only that have a direct and exclusive bearing upon its business. The wider range of technical education is for others to carry on. The chief objects of the educative effort are to stimulate interest among the rank and file of the employees and to enlist their good-will toward the company employing them.

Educating the Employee

To do this, the employee must be lifted out of the rut which so narrowly confines him to his job, and be placed in a position where he may appreciate the full activity of the industry which employs him. Such an educative program is an extensive one, and would have a vastly differing handling by the various employers who would put it in force. The lines of education are many—too many to do more than mention a few in passing.

An employee should know the business history of the company for which he works; its financial position; its position with reference to other similar enterprises in the same field; its materials sources; the characteristic processes employed; machinery's relation to quantity and quality of output; the development of new machinery and methods; the part played by employee suggestions; the control of quality; and the sales plan and relation of the company.

You may say that this is telling each employee the intimate details of your business, providing him with the means either of using them to his own advantage or of selling them out to a competitor. Although such a condition might occur once in a great while if you provide him with intimate details, the principle of the educative effort is to bring the employee into a closer relationship, making him a part of the business itself.

Employees cannot always be chosen with an assurance that their good-will goes with the employment. Leaving out that one factor is a hindrance to the accomplishment of the best in their efforts toward satisfying your client. In a great measure, the good-will of the employee is allied with the sort of service which is actually rendered to the client. Try as one may, these two elements are difficult of separation.

Education of the sort suggested, besides arousing interest and stimulating good-will, so far as your particular company is concerned, may be an effective way of developing an appreciation of economic principles in general and a greater understanding of the elements which enter into the conduct of every business. It is a condition of the human mind that it works from the particular to the general. Give it some definite items to work upon and it may carry them along until the development reaches a plane that will bring its wealth of new ideas to your business.

Large corporations have seen the value of this sort of an educative program, and have answered it through the establishment of company journals, community meetings and efforts, bulletin boards, descriptive booklets, a company library, and profit-sharing plans. What will benefit the employer of thousands of laborers will benefit the man who employs but one. Not in so great an amount, but usually in greater proportion.

Every contractor has some definite plan of progress in mind. He usually has some fairly well-defined business method which governs the conduct of his industrial effort.

Many times this is a hazy sort of thing were he to attempt to express it, but the plan exists, nevertheless. Let this be the starting point of his educative program.

To the employee, in terms which he also understands, should be presented the ideals which *your* business is to bear as its guidon. One by one the plans of the company are given to him. The next job that is to be done; the sales effort that is being made; the advertising campaign that is being carried on; the reason for choice of certain definite types or materials; each of these things will bring the employee relation into one that will develop company interest. He will feel the confidence of the employer who permits him to know the things that are ordinarily secretly worked out. The employee becomes an active part of the plans, a co-worker in every possible relation.

No one need take a day off for this. The information may be conveyed at odd intervals; not in the manner which smacks of paternalism, but in a way that will make him heartily in accord with the plans. Or—it may be that, once the employee sees that he is a part of the plan instead of being a mere cog of the business machine, he may have a suggestion here and there that will save dollars and increase values.

The factory suggestion box idea is a good one; but the "Talk it over with your employee" plan is a better one. He has had other employers; has probably observed the activities along similar lines, even though he had no part in them; from that experience may come the one thing which would render the projected effort a more completely successful one.

The employee interest in matters pertaining to his craft is the next step. You subscribe to trade papers. Pick out the one which carries on your ideals—two or three if they are necessary. Obtain an additional subscription to the papers and pass them around amongst the employees. Give every one an opportunity to read them. Ask about certain articles that seemed to appeal to you. Get them to talk of the things they have read and found interest in. Build their interest and good-will at one and the same time.

That sort of educative action is going to make *yours* a better crew of workmen. The good-will which they hold for you and for your endeavors will be demonstrated in both the quantity and the quality of the work performed. That's a real step in advance.

Educating the Client

Having settled the problem of the employee, the client actual or in prospect is the next place to build good-will. In the case of the actual client, it is an excellent plan to bring every new thing to his attention, with the ability to explain its cost, value, and use. Let him see that you hold his interests paramount. That, and the sort of workmanship afforded him, will build good-will with him.

All that is left is the handling of the client in prospect. His only source is through advertising. His choice of a contractor comes in only two ways—recommendation of friends, and advertising. When the past clients have received the service which builds good-will, they will be the ones who will do much advertising for you. To that source may be credited many a client who comes unannounced.

A sufficient number of business-bringing plans have been already afforded you so that none need exposition here. It is in the type of advertising that the advantage lies. Your card in the paper, bearing name, address and business, is never going to do much more than be entered under "advertising expense." If that is all you can afford, it would be better if you would add together the total cost for the year and use it for one big piece of advertising. It might not be working all the time, but it would be demanding attention while it did work.

The best piece of advertising that could be done is the careful stating of your business policy. Let the public know what you stand for. Let them know that you are in the business of contracting and are rendering efficient and satisfying services. Let them know that your employees are concerned about the type of workmanship in your erections. Then give them the sort of workmanship that you are advertising. Do that—and you'll build good-will while building.

Engineer's Decision Final on Contract and Subcontract

A SUBCONTRACT for highway construction specified that the work should be done in strict compliance with the original contract between the general contractor and a county "subject to the inspection, approval, and acceptance of the county engineer." Applying this provision in the case of Deal vs. Craven, 277 Southwestern Reporter, 1046, the Texas Commission of Appeals, in an opinion approved by the Supreme Court, holds that the County Engineer's acceptance of work was conclusive as to performance of the subcontract, in the absence of fraud.

One-sided Clauses in Public Works Specifications

By R. C. Marshall, Jr.
General Manager, Associated General Contractors of America

THE opinion of contractors concerning many of the contracts that they sign is so generally known that it needs no repetition; yet in all the discussions of this subject to which I have listened, the primary cause of their complaint seems to have been misconstrued. This is probably due in considerable degree to a careless use of the term "unfair," whereas the provisions commonly criticized are scored on the grounds of ambiguity or the injection of unnecessary hazard and indeterminate elements of cost.

While there are instances in which a public department or a private owner, usually assisted by legal counsel, has not hestitated to deal to contractors from the bottom of the pack, these cases should not reflect upon the great majority of engineers whose instinct is to deal fairly. It is but natural that frequent use of the word "unfair" has annoyed the engineering profession considerably in discussion of its contracts, and has succeeded in beclouding the effect of certain contract provisions on cost and business management. Probably the best thing that can happen for all elements concerned in this important matter of contracts, is to forget the term "unfair" and to investigate more carefully a few economic principles which the construction industry generally seems to have overlooked.

Quantities and Overhead

State highway specifications usually set up an estimate of quantities by which the contractor determines his overhead costs and to which at so much per unit these costs must be distributed. If some of the units are omitted, the overhead assigned to them is left uncovered and stands as an uncompensated expense of the work. Yet most specifications provide that the Department, without making any adjustment whatever, has the right to increase or diminish these quantities or leave out any portion of them altogether. Obviously, a material reduction of quantities or even an extension of the work, if prices are rising, changes the actual unit cost of the work. Thus, the contractor builds something different from what he was led to believe he would build, and in effecf the original basis of the contract is altered. This the courts have so held repeatedly where increase or decrease of quantities is excessive, and it may be added more than 10 per cent may often be interpreted as excessive.

There is no question but what these changes must be made on occasion, and some proper provision therefor should be included in the contract; otherwise the bidder can protect himself only by changing his overhead to those units most likely to remain constant, thus unbalancing his bid, or by adding an item of contingent expense in his estimate. Since changes must be made, since court interpretation of these unlimited right-of-change clauses is quite clear; and since they add an item of cost to the work, it might be well to eliminate them in favor of a more scientific provision. In a few contracts this question has been handled by giving the department a right to change the quantity of the work up to, say, 5 per cent without change of price, and by having the bidder state unit prices in his proposal for other percentages of change. This plan, I am advised, has been tried successfully by a number of engineers.

Concealed Elements of Cost

The effect of so-called drastic contract provision upon the actual cost of a construction project does not seem to be very generally appreciated. By a drastic clause is not meant one that provides swift and sure penalty for violation of contract, but one which makes impossible an accurate estimate of cost, which tends to conceal elements of cost from a bidder, or which makes acceptance of the other contracting party's opinion a condition precedent to payment. These clauses appear to have grown out of a perfectly natural desire of the owner and his representatives to be protected against every possibility of loss until their project is delivered complete and unencumbered.

No one can justly blame them for wanting this protection, but it should be apparent that this assurance in connection with a construction project, dependent as it is upon so many uncertain factors, actually involves a significant

item of cost. When a contractor guarantees a structure against acts of God and all other contingencies of construction, he has underwritten about the worst risk to be found in industry. No insurance company will underwrite it and he must carry it himself.

Some of these hazards can be more cheaply assumed by the owner than by the contractor and the insurance premium eliminated from the cost of construction. I presume that one reason why this is not generally done is that we have always with us a supply of individuals who will gamble at anything and frequently the owner can find a bidder who attempts to conduct an insurance business without collecting a premium.

In general, these so-called drastic provisions affect the cost of construction in three ways:

First, by introducing hazards or uncertainty of requirements which the construction company cannot estimate and which must therefore be covered by a contingency charge.

Second, by restricting competition, and third, by actually increasing the cost of operations through specifying unattainable perfection or increasing the financing charges of the work by heavy retainages or delayed payments. A few examples will serve to show that the effects mentioned are real and not illusionary. As a clear example of introducing unnecessary hazard, a quotation from the general conditions of the standard contract of the American Railway Engineering Association will serve. This clause states that:

"Should any work or material be required which is not denoted in the specifications or plans, either directly or indirectly, but which is nevertheless necessary for the proper carrying out of the intent thereof, the contractor is to understand the same to be implied and required and shall perform all such work and furnish any such material as fully as if they were particularly delineated or described."

Another good example found in various state highway contracts is as follows:

"The engineer may, by written notice to that effect, suspend all or any portion of the work if, in his judgment, the same cannot be properly done for any reason beyond the control of the contractor, but no allowance of any kind will be made for such suspension except an extension of time for the completion of work."

These clauses and others of similar nature are accompanied by a clause giving the engineer (in effect one party to the contract) final decision in all matters of disagreement. The possibility of extra cost which cannot be foreseen or estimated by the construction company under such provisions is obvious. Of course where it is possible to sue the state, and the amount of money involved is sufficient to warrant legal action, the contractor can recover in spite of this clause if he has sufficient cause. But some states cannot be sued. Often the amount involved would merely pay the attorneys' fees, and consequently the construction company charges it up to profit and loss. Any contractor who does not put in his bid some sort of a contingency allowance for these provisions, is ignoring the most elementary principle of sound business.

It is difficult for a bidder who knows his operating costs, and also knows the cost of insuring owners against acts of God and other contingencies, to believe that the clauses here mentioned are not a premeditated effort to get something for nothing. In a measure perhaps they are—not that a department expects to get units of work without cost, but that it seeks a protection which should be underwritten by Lloyds of London, yet fails to perceive that premiums therefore must be charged as an element of cost.

Limiting Competition

On occasion the insurance premium to cover contingencies may be forgotten or crowded out of an estimate by ignorant bidding, but there has yet been devised no way whereby a department can recover the loss occasioned by inadequate competition. Competition may be lost either by making contracts too drastic or by using clauses which make it impossible for many bidders to undertake the contract.

I have no specific contract to quote in this instance, though I have seen many of them which automatically reduced the number of bidders. This can be done by requiring commencement of the work within specified time. I know of a certain project on the Mississippi River where such a provision stipulating thirty days eliminated all the contractors on the west coast some of whom were anxious to bid on the project.

When a contract contains a date of completion with penalty, the date of commencement is of little practical value. In the first place, commencement may be superficial yet legal, and in the second place, it is practically impossible to determine when the work is actually begun. Assuming the commencement can be clearly defined and determined, there is still the possibility that the limit set will exclude any bidder, however suitable, who cannot release equipment on some other project for thirty-five, sixty, or ninety days. A more rational procedure would be to eliminate the date of commencement and hold to the necessary rate of progress for a specified date of completion.

Probably the most outstanding effect on cost to be noted is that of increasing the direct construction expense. An example from the Federal Government will show how this occurs. One of the departments had a project estimated to cost about two million dollars, and after extensive advertising they received but two proposals. As this department had signified its intention of departing from day labor, the Associated General Contractors exerted its efforts to interest contractors all over the Western states in this project. Many of them said that they would bid unless the contract form was found to contain a joker.

Unfortunately, the contract did contain a joker, which prevented many firms from submitting a proposal. The trouble was in the payment clauses. An analysis which one of the companies gave to me indicated that by reason of terms of payment it would be necessary for a contractor to have something like eight hundred thousand dollars of his own money tied up in this two-million-dollar project before it was completed. These provisions automatically eliminated a great number of bidders who could have handled the project satisfactorily under usual terms of payment. Not only that, but the clauses used injected into the work an unnecessarily heavy item of interest.

Some of the state highway specifications hold back 15 or 20 per cent as a retainer, which merely adds an unnecessary item of interest and reduces the number of marginal bidders capable of handling the project. I do not say that this always reduces the number who think they are capable of handling the project, because hope springs eternal in the contractor; and the more inexperienced he is, the farther it springs.

Heavy retainages seem to be of little practical value, since they are not large at a time when a dishonest concern is most apt to default, and often bring on default by increasing the financing problem of the contractor at a time when his other difficulties are at a maximum. The policy of reducing the retainage when the job is half-done, or of making progressive reduction when it progresses satisfactorily, has I believe been thoroughly justified by the experience of those departments that have tried it.

Arbitration

In any discussion of contracts it is difficult to keep from drifting more or less deeply into the matter of arbitration, as it affects vitally the attitude of the contracting parties toward each other as well as the character of construction service. I will not go deeply into the pros and cons, but I hope that all parties concerned in the construction industry will give this subject more analytical study in the future, as it offers great possibilities in removing much of the friction encountered by the various elements of industry in their transactions with each other.

In our office are on file a great many subcontract forms used by members of the Associated General Contractors, practically all of which contain an arbitration clause. This clause was not put in at the instance of subcontractors who demanded a means of impartial determination but was put in by the general contractors themselves, who realized the benefits to both parties. It is possible that the engineering profession like the architectural profession, and contractors, will upon further study arrive at the same conclusion.

Construction is, I believe, the only industry in the United States wherein the purchaser is generally opposed to arbitration. This may or may not be significant, but I believe it is one indication of why the construction industry is struggling with business practices and economic problems that have long ago been solved by other industries. Those industries have ceased to debate as to whether an arbitration clause between buyer and seller is advisable and have turned their attention to the necessary means of enforcing arbitration awards where such means are not already provided by law.

At the last session of Congress, a Federal law was enacted to make enforceable written agreements to arbitrate disputes arising out of contracts, maritime transactions or commerce among the states or with foreign nations. Similar laws suitable to state needs have been passed by New York, New Jersey, Oregon, and Massachusetts, with other states likely to follow.

In the discussions on arbitration that have come to my attention, it seems to have been assumed that the agreement to arbitrate is something which acts purely in favor of the general contractor and is something that the other party to the contract more or less gives him as a present. No conception could be farther from the actual truth. Arbitration when properly written into a contract gives the contractor nothing that it does not give the owner and it strengthens immeasurably the hand of the engineer.

I believe there is no greater evidence of the need of arbitration than that given by the enormous record of lawsuits in construction.

In a vast majority of these, the decision has favored the contractor. Often the contractor has won on a technicality that would never have been countenanced by an arbitration board drawn from within the industry. The man who is acting in bad faith will invariably seek the court with competent counsel in preference to seeking arbitration.

These points, however, do not represent, in the judgment of those who have tried it most thoroughly, the principal value of an arbitration clause. The American Institute of Architects has long used such a clause in its standard contract and would not think of doing otherwise. Its representatives on the Joint Conference on Standard Construction Contracts indicated that the Institute would not participate in the Conference if it proposed to draw up a contract form without provision for arbitration. This they considered a backward step which would have destroyed the work done within their society throughout nearly a generation.

The form of arbitration contained in the Conference Document, and that which is most widely favored, gives the engineer full authority as to the result to be produced and the same control of the work that he has always had, and merely provides that disputes involving extension of time or compensation in accordance with the terms of the contract shall be settled by agreement or arbitration.

The greatest value of such a provision is not in its actual exercise to determine monetary awards, but in its effect upon the attitude of the contracting parties. Its chief influence is to prevent the assumption of hasty or arbitrary stands from which neither party will willingly retract, and to bring about agreements which are mutually satisfactory without resort to legal action. The representatives of the American Institute stated before the Joint Conference that, in their opinion, it not only eliminated in most cases the need for litigation but also the need for arbitration itself.

On the contracting side of the fence, we look forward hopefully to the establishment, not only of arbitration but also more standardized contracts in general, which will gradually build up a sound and enforceable code of contracting practice. We believe they will facilitate interstate competition, decrease disputes and litigation, and tend to make it more difficult for any dishonest concern to continue operations.

Defaults

As one considers the record of defaulted contracts, particularly in highway work, it seems very likely that both engineers and contractors have not perceived the limitations of a legal contract. By this I mean there seems to be a feeling that if a contract is sufficiently air-tight for one party or the other, that party has protected itself in every possible way. Yet if we consider the matter carefully, we realize that no form of contract can produce a high grade of work and honest performance from a low-grade contractor who is dishonest.

Instances are innumerable where projects have been awarded to contractors with full knowledge that they could not perform the work satisfactorily and would eventually default. The evils of such procedure and the trouble it has caused from one end of the country to the other are too generally known to bear repetition. It is a procedure which no sane man would follow in buying a suit of clothes.

This is not offered as a criticism of engineers, because we all know what the engineer in charge of public construction is up against in awarding contracts. Until he receives sufficient support from the responsible element of every group concerned in construction, and until these groups make it their business to see that the engineer with the courage of his conviction is not made the victim of political expediency, they must suffer the consequences.

ACKNOWLEDGMENT.—From a paper read before the American Road Builders' Association, Chicago, January, 1926.

Premiums on Surety Bonds

IN the case of American Surety Company vs. Bristow 131 Atlantic Reporter, 312, the Rhode Island Supreme Court ruled that circumstances were such that plaintiff was not entitled to recover an additional premium as surety on defendant's bond as road contractor, although the work covered by the bond was not completed within one year:

"The application was for a bond of suretyship for a certain amount for which the applicant was to pay a stated premium. . . . The application was accepted unconditionally and without notice to the defendant that he would be charged an additional premium if his contract was not completed within one year after the date of the bond. The bond was not issued for a limited time, and no renewal or extension of it was necessary, because it was conditioned to remain in effect until the defendant performed his contract with the city. The plaintiff was not required to accept the application and if it wished the defendant to agree to pay an annual premium until it was discharged from suretyship on the bond, it could have insisted that such agreement be written in the application."

Machine Finishing on a 12-Mile Georgia Road

Davis Construction Company Finds Machine Finishing Far Surpasses Hand Work

By O. B. Duncan

Yancey Brothers, Atlanta, Ga.

IN December, 1924, the Davis Construction Company, Atlanta, Ga., purchased from Yancey Brothers, 550-556 Whitehall Street, Atlanta, Ga., an Ord concrete road finisher for their Clayton County road project, which calls for the construction of 12 miles of 18-foot concrete road, the surface to have a 2-inch crown. The road was built full width in one unit. No expansion joints were used except at the end of the day's work or whenever it was necessary to shut down operations for more than 30 minutes.

In passing over the fresh concrete, the screeds, which set up a kneading motion, bring the water to the surface, as well as enough mortar to make a smooth and attractive job.

If the forms are properly set, there are no irregular surfaces or waves in a road finished by this machine, and the crown will be as nearly perfect as it is possible to make it, according to the contractor. For superelevated curves, there is a flat screed that can be quickly installed without very much expense.

ORD FINISHER AT WORK ON GEORGIA ROAD JOB

At left, strike board is seen pushing 6 or 8 inches of concrete ahead. At right, finished pavement, showing uniformity and smoothness of surface

W. R. Neal, State Highway Engineer of Georgia, after watching the finisher at work, remarked that it was doing a much better job than could be done by hand methods, and he particularly liked it because of its ability to handle dryer concrete than could possibly be used with hand methods. The machine saved labor, as it required very little spreading of the concrete in front of it; it strikes the concrete off and pushes ahead of it 6 or 8 inches of concrete, which in trying to crowd under the heavy screed has a tendency to pack the concrete and fill all voids.

J. D. Davis, President, Davis Construction Company, states that his first machine has finished 210,000 square yards of pavement at a cost for repairs and upkeep of less than $25, and the machine is still good. He expects that before it is worn out it will finish at least 400,000 square yards of pavement. Mr. Davis states that he would not start out on a concrete road paving project without one of these machines, and he is now using two of them. Practically every road paving project in Georgia is now a machine-finished job.

Hollow Building Tile Standards Revised

AFTER having been in effect nearly two years, the Simplified Practice Recommendations as to hollow building tile, which reduced 39 sizes to 19, have been revised. The original conference, held in October, 1923, under the auspices of the Division of Simplified Practice, U. S. Department of Commerce, based the limitation of dimensions on the results of a survey conducted by the industry. The revision, which was adopted in Chicago in February, 1926, reinstates but one size not included in the previous simplified list and makes only slight modifications in other items.

The survey which preceded the conference was based on figures supplied by 143 of the 201 companies in the United States making this product. These 143 companies produce more than 78 per cent of the total tonnage of the country, and the figures compiled in the survey were based on the number of hollow tiles made during the year 1924 and the first half of 1925. It was shown that in the "recognized sizes" the demand had steadily increased, while the orders for sizes outside of the simplified list had dropped to a negligible figure.

The single size which was added under the revision program was a wall tile 8 inches by 8 inches wide, 9-cell construction. This was found in the survey to be in growing demand as a result of building trends and requirements.

Tunnel and Timber Work in Large Sewers

By George M. Shepard
Chief Engineer, Department of Public Works, St. Paul, Minn.

THE general system known as the Belt Line, Phalen and Hazel Park sewer system in St. Paul is shown in the General Plan and comprises approximately 14 miles of various sizes of sewer, the maximum being a 12-foot horseshoe section, which is part of a $7,000,000 program of relief and trunk sewer construction being carried out by the city. The district of six square miles which this system serves is of glacial drift formation without any well-defined drainage courses. The succession of depressions and knolls impose a condition of sewer depths varying from slight fills to as much as 90-foot cuts. As a result, approximately 1,000 feet of tunnel for the 12-foot section was neces-

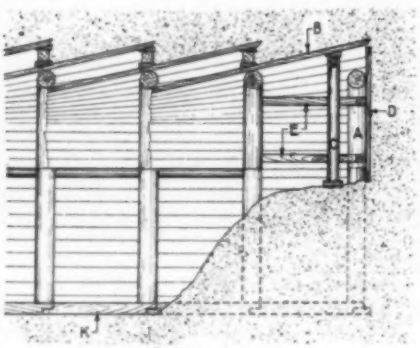


FIG. 1

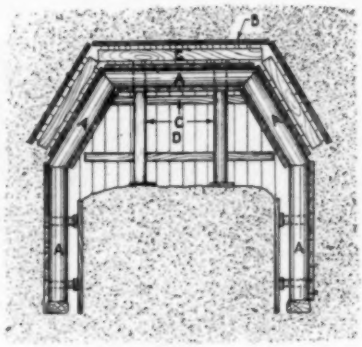


FIG. 2

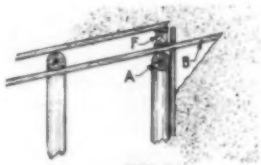


FIG. 3

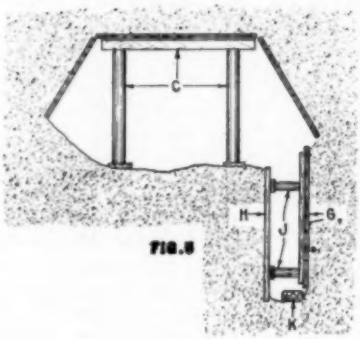


FIG. 5

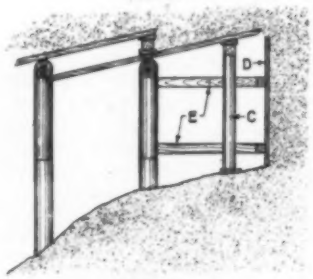
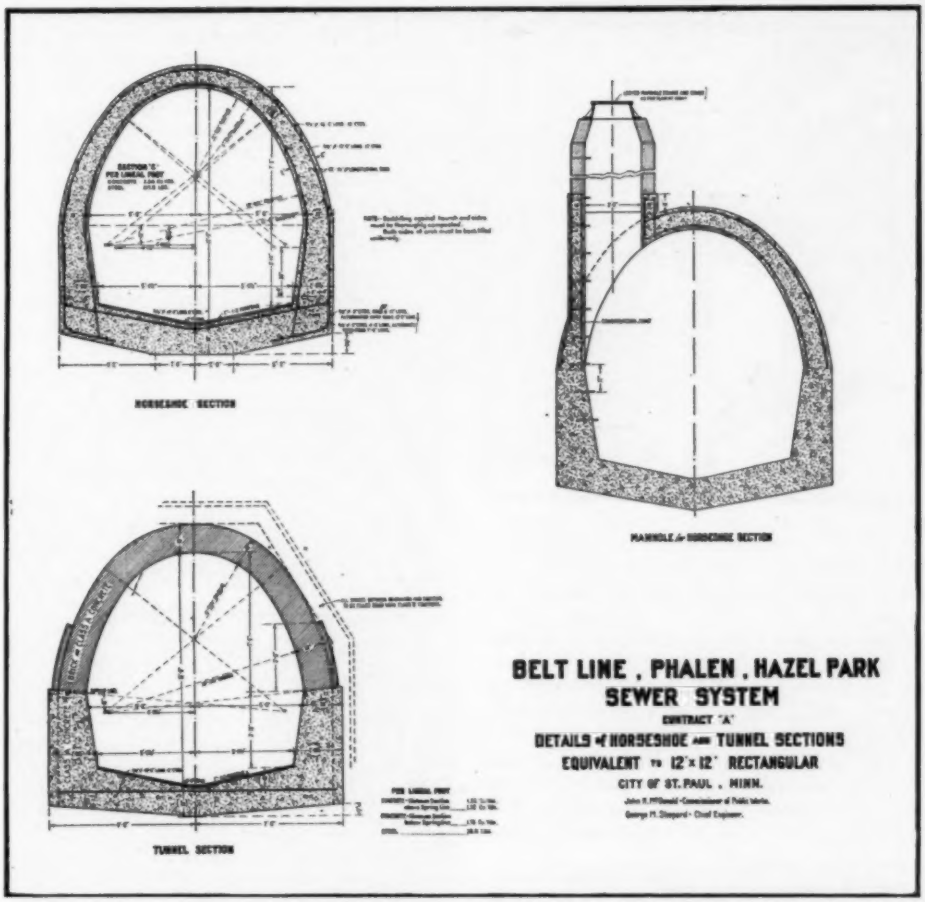


FIG. 4

GENERAL PLAN OF CONSTRUCTION IN TUNNEL


BELT LINE . PHALEN . HAZEL PARK
SEWER SYSTEM
CONTRACT "A"
DETAILS of HORSESHOE and TUNNEL SECTIONS
EQUIVALENT to 12'x 12' RECTANGULAR
CITY OF ST. PAUL . MINN.

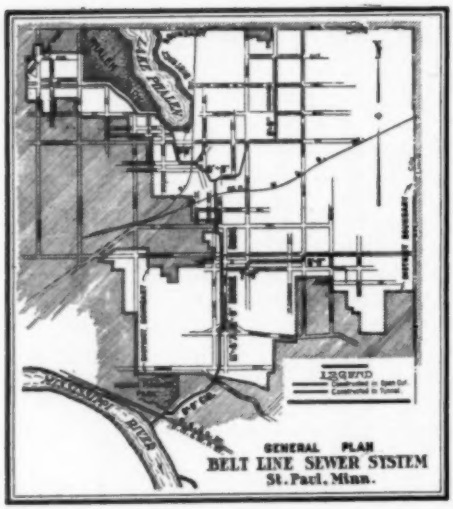
DETAILS OF SEWER SECTION FOR OPEN CUT AND TUNNEL WORK

sary, and 2,300 feet of tunnel for the 8-foot section. In addition to tunneling for the greater depths, several of the main highway thoroughfares and one set of railway tracks were tunneled so as not to interfere with traffic.

The material encountered is glacial drift consisting of varied materials, the change from one material to another frequently taking place very abruptly. A fine sand was encountered, principally on the larger tunnels, and a water-bearing sandy clay with a small amount of gravel, also some water-bearing fine sand in the smaller tunnels. The problems involved in timber work in this class of material are not new, such methods having been used in the mines of northern Minnesota for a great many years. Had greater lengths of tunnel work been necessary, undoubtedly improved methods with shields and air could have been used. The work as carried on, however, is interesting to the average contractor and engineer, and with this in mind the following description has been prepared:

The construction follows the general plan of heavy timber "sets" placed between 4- and 5-foot centers, with poling boards driven or placed in advance of the heading. Where water-bearing seams were encountered at the crown of the section or above the spring line, it was necessary to bulkhead the upper portion of the heading and in some cases to pack with hay or straw as soon as the material was removed.

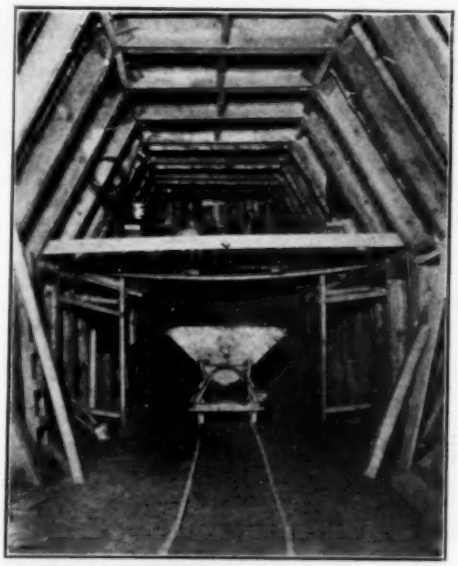
Figure 1 is a longitudinal section showing the appearance of the tunnel immediately after the set "A" has been placed. The poling



boards "B" are supported by the temporary cap and posts "C," and the breast boards "D" are braced back against the following set by braces "E."

Figure 2 is a cross-sectional view showing the heading under the same conditions as Figure 1. The next operation is to transfer the support of the poling boards to the new set. This is done by placing the transverse timber "F" (Figure 3) directly above the cap and blocking and wedging between the boards and cap. The blocking between the timber "F" and the cap "A" is of such thickness that the opening left will permit the entrance of a poling board "B." Then the center breast board is cut through by drilling and the poling board driven a short distance. A portion of the breast board is then removed and the earth under the poling board excavated. Other poling boards are introduced in a similar manner on each side, and the excavation is widened and deepened.

As soon as the excavation has proceeded to such a point that the poling boards require support, temporary posts "C" are placed as shown in Figure 4. In sand there may be several sets of temporary posts used. Short posts

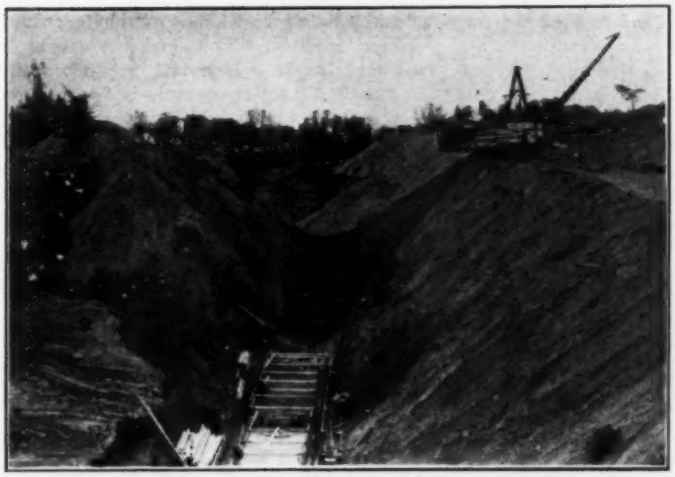


HEADING AND TUNNEL WORK FOR 12-FOOT TUNNEL SECTION

Bulkhead at top of heading and side drifts were required because of fine sand

TIMBERING ON CURVE FOR 8-FOOT HORSESHOE SECTION

are then progressively replaced by longer ones as the process of widening and deepening the heading proceeds. The face is held in place by breast boards "D," which are braced against the preceding set by braces "E." Where the soil will stand up for a short time, the entire face to about a man's height is dressed down before placing breast boards. In sand small breast boards must be placed as soon as the face is reached, and these must be gradually replaced by larger boards, as the face is widened and deepened. Three poling boards on each side of the top, and eight along each sloping side, are made fan-shaped, as shown in Figure 1, so that they will completely retain the earth as the area widens



DRAGLINE WORKING IN OPEN CUT

Insert for 12-foot sewer shown in foreground

out laterally.

Figure 5 is a transverse view of the heading. The left half shows the appearance after all poling boards have been placed. The next operation is shown on the right half of Figure 5. A trench is carried downward and progressively sheeted by the boards "G" and "H" braced by "J" until the sill "K" may be placed. After both sills have been placed, the posts, segments, and caps of the next set of timbering are placed.

Line is carried forward from several plumb-lines suspended from sets to the rear. Grade is carried on each side of the tunnel by small white boards nailed to the posts at a predetermined number of feet above top of sill. As each sill is placed, it is brought to proper elevation by sighting back along the grade boards.

Concreting was done by hauling the concrete in cars into the tunnel from a mixer located outside, the track being elevated as much as possible above the floor of the tunnel in order to save handling. Wooden forms were used for the 12-foot tunnel, and steel forms for the 8-foot tunnel. The entire space between the timbering and forms is filled with concrete, the concrete on top of the forms being shoveled into place and rammed back to fill the entire section between the forms and the timber work.

Cost Data

Approximate cost figures indicate that for

CONCRETING BARREL FOR 12-FOOT SEWER IN 60-FOOT OPEN CUT

the 12-foot tunnel the total cost of driving, including excavation, was approximately $54 per foot, of which $19 per foot was for timber. These figures do not include the contractor's profit. The approximate cost of concreting was $71 per foot, this being on the basis of $17 per cubic yard in place, the total cost for the tunnel complete being $125, not including the contractor's profit.

For the 8-foot tunnel section only about 500 feet out of a total of 2,300 feet has been completed; 7 x 10 shafts were used, the total cost per foot of sinking the shafts being approximately $43. The approximate cost for driving, including labor and timber for the amount already driven and a proportion of cost for hoisting equipment, is $45 per foot, of which amount $8 is for timber.

On account of water-bearing sand and gravel seams, it was necessary to install pumps at each of the two main shafts of the 8-foot tunnels. Hoists with approved safety devices were installed, and operated by steam engines from the same boilers as the pumps.

ACKNOWLEDGMENT.—From a paper read before the American Society for Municipal Improvements, at Des Moines, Iowa.

France Investigates Paving

Translation of Paper by Prefect of the Seine

IN a recent issue of *La Journée Industrielle* the Chief Administrative Officer of the Department of the Seine, which includes the city of Paris, gave some interesting opinions of various classes of street paving materials. The Prefect of the Seine described successively the advantages of asphalt, trials made to discover the ideal system of highway surfacing, and improvements which have been realized. Efforts have been made to locate products to replace macadam, which is non-resistant to Paris traffic; asphalt, which is too smooth; and, finally, wood block paving, because of its too burdensome maintenance problems.

The Prefect of the Seine sets forth his experience in the following manner:

1. *Improvements in Wood Block Paving.*—Interesting results have been obtained, but it appears to be an established fact that the improvements have been realized only at the cost of greatly increased expenditures.

2. *Search for Substitutes for Asphalt.*—Concrete and asphaltic mortars mixed in cylinders have given good results in streets where traffic is light and rapid, and, on the contrary, have been unsatisfactory in narrow streets with congested traffic and where the streets are frequently cleaned, asphalt being much more of a success in such cases. Asphalt block has given good results on the Avenue Henri Martin and the Avenue du Bois-de-Boulogne, which are wide and parked residential streets; and poor results on the Rue de Babylone and Rue Lobineau, which are narrow streets with congested traffic. Bituminous concrete surfacing lends itself to streaks and depressions. Thanks to the presence of large aggregate in the mixture, it is hoped that these pavements will be less smooth than asphalt [probably referring to sheet asphalt] even after the disappearance of the streaks. The lasting qualities of this product have not yet been determined. Synthetic asphalt is equivalent to asphalt naturally mixed, but is a little less costly. Cement concretes are not very smooth and not costly. The administration reserves its opinion for the present as to their durability. Nevertheless, the actual impression is favorable with respect to solidity, in spite of several disappointments in the beginning. Experiments have been made with tamped concrete made with an extra-rich proportion of super-portland cement, which seems to work out well.

Reinforced Concrete

Reinforced concrete and concrete without reinforcement will be tried in 1926 in the Rue de Flandre, a street with heavy traffic.

3. *Mosaic pavements in natural or artificial materials* (United States paving bricks, "Silifer," "Sigot," etc.) constitute a perfect solution from the points of view of cost of placing and maintenance, but this pavement is relatively noisy. Search will be made to improve it by adding a surfacing coat of "Spranex" or a bituminous emulsion. Brick pavements should be followed up, as they appear to be suitable for streets which have practically no horse-drawn traffic. On the other hand, the breakage must be considered.

4. *Non-slipping ("antiderapants") Surfacing.*—The Prefect states that this surfacing material will be experimented with on asphalt pavements. These trials, induced by similar experiments made in England, will be carried out in the near future, and the English products, "Colas" and "Rubgrip," manufactured with a rubber base, will be used. In conclusion, Monsieur Bouju refused in any case to condemn the use of asphalt.

We are indebted to George Orr, American Consul in Charge, Paris, France, for this interesting summary of studies and experiments in the Department of the Seine, which appeared in *Le Journée Industrielle.*

Establishing the Responsibility of Contractors

By S. M. Williams

Vice-President, Autocar Company, Ardmore, Pa.; Chairman, Committee on Uniform Questionnaires, Joint Conference on Construction Practices

AS a public, we have failed to realize our personal interest in, and our obligation toward, the construction industry. The second largest industry in the United States, it is an industry, including both engineering and building construction, which is intrusted with the expenditure of approximately $8,000,000,000 annually. If any industry is to be of value to a community, state or nation, it must be successful, and to be successful it must be surrounded with conditions and influences that are economically sound. According to the statistical department of the United States Internal Revenue Bureau, 41.67 per cent of the construction corporations filing reports covering work for 1921 showed no profits. This indicates that there is something wrong. An analysis of these reports shows that 38 per cent of the highways and excavating contractors filing reports showed no profits, 25 per cent of the building contractors, 50 per cent of the railroad contractors, 42 per cent of the dock and wharf contractors, 60 per cent of the shipbuilding contractors, 47 per cent of the wrecking and moving contractors, 42 per cent of the equipment and machinery installation contractors, and 40 per cent which include miscellaneous contractors.

It may be said that 1921 was a bad year, but it was not unusual and is comparable to the figures for 1923. The percentage of those filing reports and showing no profit in 1923 was 35 per cent, which did show a slight improvement over 1921. An analysis of the 35 per cent showed that 40 per cent of the highway and excavating contractors filing reports showed no profit, 31.68 per cent of the building contractors, 40 per cent of the railroad contractors, 42 per cent of the dock and wharf contractors, 55 per cent of the shipbuilding contractors, 32 per cent of the wrecking and moving contractors, 30 per cent of the equipment and machinery installation contractors, and 38.8 per cent including miscellaneous contractors.

The statistics of the United States Bureau of Internal Revenue for 1921 and 1923 also showed the average gross profit for the contractors filing reports and showed a profit of 2 per cent before deducting Federal and state taxes. After deducting the taxes and without taking into consideration interest on unpaid capital, the contractors of the United States made an average profit of less than 1¾ per cent.

In quoting the above figures it is only fair to refer to the experience of other industries as shown by the Bureau. Of the manufacturers reporting incomes, 63.53 per cent showed profits and 36.47 per cent showed no profits. Of the agricultural corporations reporting, 41.48 per cent showed profits and 58.52 per cent showed no profits.

Comparison of the percentages for 1923 shows slight difference between the construction and manufacturing industries and a greater percentage of no profit returns for the agricultural industry, but the information from the Bureau further shows that for the 63.53 per cent of the manufacturing corporations showing profits, it averaged 10 per cent, and for the 41.48 per cent of the agricultural corporations averaged 15 per cent as against 1¾ per cent for the 65 per cent of the construction corporations filing reports and showing profits.

As further evidence of the unsatisfactory and uneconomic conditions, I would refer to the loss ratios experienced by one of the oldest and most conservative and responsible surety companies for the years 1921, 1922, 1923 and 1924, which were as follows:

Loss Ratios—Years 1921-24 Per cent	
	Contracts Other Than Federal
113.....	Concrete roads and highways
94.....	Water-bound macadam highways
65.....	Dirt, gravel, shell roads and highways
91.....	Drainage and ditching
64.....	Sewers, aqueducts, and pipe laying
37.....	Refuse disposal plants
59.....	Excavation and grading other than railroad
41.....	Public buildings, construction other than concrete
55.....	General construction except concrete
	Federal Contracts
164.....	Federal contracts—miscellaneous
51.....	Harbor and river improvement
219.....	Construction for Navy Department
141.....	Construction for Interior Department—miscellaneous

NOTE: In publishing these figures the surety company states "to the loss ratios must be added 50 per cent to cover expenses."

The foregoing company also reported for the year 1923, 1,790 defaults upon construction work.

Another conservative and well-known company reported as paid in losses for 1923 92½ per cent of all premiums received on road contract bonds, which did not include administrative expense, agent's commissions and Federal, state, or municipal taxes.

Contract bond losses are eventually reflected in premium rates charged for bonds, and are finally paid by the public.

Who Is Responsible for These Conditions?

Primarily, the general public is responsible for such conditions, because it is in a position to control all of the elements of construction, and in the end the public is paying the bill from the present uneconomic conditions in the industry.

Practically every analytical study of the industry to ascertain measures necessary to clear it of existing conditions has led to the same fundamental problems. Regardless of the methods considered, the ethics, financing, contracts, or contracting service, it has invariably resulted in realizing the public's failure to recognize distinctions between classes of contractors and their encouragement of commercial practices which continually induct irresponsible and dishonest individuals into the industry and maintain them there at the expense of reputable individual, public and private owners.

To be more specific, any individual, regardless of finances, experience, or responsibility, is generally permitted to bid upon public construction, and, if he is low, is awarded the contract, providing he is able to furnish a bond. In the majority of public work the law provides that the contract must be awarded to the lowest responsible bidder, and because of the readiness of the public to point the finger of suspicion, the public official has been afraid to undertake the determination of the responsible bidder. He has passed that responsibility on to the surety company.

You will realize that the surety companies have failed in meeting their responsibility when the president of one of the largest and oldest surety companies states as chairman of a committee reporting to a joint conference of public officials, contractors, surety companies, and surety agents in White Sulphur Springs on September 18, 1924, that "practically any contractor, whatever his financial standing, whatever his experience or lack of experience, whatever his equipment, sufficient or insufficient, whatever the relation of his liquid assets to the amount of work he has at hand, whatever the extent to which he has become over-extended, can obtain a bond. Some surety company will execute a bond for him."

The same report said, "When a surety company writes a bond for a contractor, the surety company and the contractor become in effect partners. If there is a default, the owner suffers delay and other consequential losses not covered by the bond. The contractors, the surety companies, and the owners are therefore interested in the establishment of conditions under which defaults are least likely to occur."

In private construction it is known that frequently through their engineers and architects owners will accept bids not only from contractors of high standing as to character, experience and responsibility, but also from contractors whose reputation for past work is decidedly below that of the better class of contractors. The differences are so far apart that the owner, architect, or engineer has no right to expect from all the same class of work. The owner, if he considers his own interest, does not want to award a contract to a contractor of questionable ability or reputation, but frequently is willing to use the low price as a factor in his attempt to browbeat a responsible bidder to accept the lower price of the irresponsible bidder.

Some owners will admit that the low bid is from a low-class contractor, but will argue that the contractor agrees to build on the same specifications and that his engineer or architect is paid a fee for insuring good work. It is not fair or practical to place such a responsibility upon the architect or engineer, because it is unreasonable to expect high-grade work from a low-grade source. Price is not so flexible that there can be much variation without an actual difference in quality.

It is well to have all the competition possible; but if you want cheap work, then keep out the high-grade contractors. If you want good work and real economy, do not allow the low-grade contractor to set the pace. Do not invite the low-grade contractor to bid, and then use his price to batter down the price of a high-grade contractor.

In commenting upon the situation, the *Engineering News-Record,* under date of September 17, 1925, said: "Quality performance has a vague influence on owners and engineers and architects, but the influence recedes perceptibly before the impressiveness

of the low bid. There is hardly any other activity where relative quality is not rewarded. Convincing the owner that there are variations in contracting and that higher quality warrants higher price is the fundamental solution."

The owner is not always responsible for such practices. It is sometimes the banker or some financing organization. Each must assume his responsibility. Some one representing the owner should have the courage to stamp such practices as unfair and not in his interest or that of industrial progress.

The success of financial institutions largely depends upon the prosperity of those within their communities. The financing of irresponsible and inexperienced contractors, and especially beyond their limitations, does not insure profit, but it is not an uncommon occurrence among financial institutions.

I once heard an interesting definition of an optimist as a man who sells equipment to irresponsible contractors on long-time payments and expects to get his money. Those who have studied the situation in the construction industry sometimes feel that the same definition might be applied to some of our financial institutions that are willing to finance the contractor of questionable character, ability, or responsibility to the detriment of a contractor of high standing, and, finally, of the general public, because, after all, the public suffers from incompetency.

A statement issued on May 12, 1924, by the American Construction Council contains the following: "One very serious situation confronting the country requires special attention. A large percentage of present-day building construction throughout the country is distinctly inferior in quality and unsound in financing. Thousands of such structures now under way or recently erected, especially in housing, are subject to such rapid deterioration that in ten years' time, sometimes less, they will be practically valueless. Faulty engineering, unreliable architects, inexperienced and incompetent contractors, inferior grades of material, poor machines, inadequate and poor inspection, and other factors too frequently enter into building work."

Referring again to the bonding situation, R. H. Towner, founder of the Towner Rating Bureau, stated in a letter written to A. R. Marsh, Editor of the Economic World, and published in that paper under date of March 28, 1925, that "surety companies seek to learn a contractor's financial conditions, the amount of other contracts he has on hand, the rival bids for the new contract, and the contractor's probable ability to complete it. They are often deceived in one or more of these important factors. They are often required to give a 'Surety's Consent' or bid bond agreeing to execute his contract bond without seeing his own bid, and, of course, without having seen any of the other bids.

"It is on these terms that surety companies go on year after year perpetually bonding the lowest bidder on construction contracts, that is, with the selection of risks perpetually against them.

"This is where they suffer a perpetual disadvantage that is unknown to other branches of insurance. Other insurance branches can distribute the losses of average risks or even of selected risks, but because contracts are always awarded to the lowest bidder, surety companies have to bond these companies that have underbid all the others. The average risk would be the highest bidders, the worst risks are the lowest bidders, and these are what the surety companies guarantee. It is not the lack of 'standards' in contract bond underwriting; it is because the contract is always awarded to the lowest bidder. This breaks the contractors themselves in the long run, so that contract bond underwriters have a maxim that any man who keeps in the contracting game long enough goes broke. New money and new blood must be poured into the contracting game or there will be no contractors for surety companies to bond."

Mr. Towner's statement reminds me somewhat of the published articles from insurance circles during 1924 and 1925, which argued that if the surety companies were not willing to bond the irresponsible contractor, the public would suffer, because there were not enough of the responsible contractors to undertake the work. Such an argument is, of course, begging the question and unworthy of consideration, because it is the bonding of the irresponsible contractor that is discouraging capital from entering into construction work and discouraging the responsible contractors already engaged therein.

A. R. Marsh, mentioned above, replied under date of March 24, 1925, saying, "It would be difficult to imagine a more lunatical situation than of a great body of contractors in every part of the land, all of them destined to inescapable ruin in the long run by the very nature of their business, but all of them given the indispensable support of the surety companies while they survive, with the understanding that when the fatal day of disaster

finally arrives the surety companies will carry through the undertakings that brought them to grief. It is a little hard to believe, however, that one of the greatest of our national industries, the construction industry, is really in so desperate a plight as this, or that our surety companies are knowingly engaged in so hopeless a game. On the other hand, it seems to us that what Mr. Towner has to say about the mischief caused by the fact that 'the contract is always awarded to the lowest bidder,' with the result that the only risks the surety companies underwrite are those of the 'lowest bidders,' is an exceedingly strong argument in favor of that very scientific standardization of underwriting practice, which is the object of 'contract bond reform.' For no contractor can be the lowest bidder on any construction contract who cannot procure a surety bond guaranteeing the fulfillment of the contract, and the first effort of standardized underwriting practice in this field would be to render it impossible for any contractor to be the lowest bidder anywhere who could not meet the requirements of a scientifically administered rating system."

The public and the surety companies are not entirely to blame for present conditions, although primarily they are important factors. The engineer or architect in either public or private work should not, in justice to his obligation to the public or the owners or both, award a contract where the amount of the bid is below an intelligent estimate of cost plus a fair and legitimate profit. I personally believe from observation and experience that for every dollar supposed to have been saved by awarding a contract for the lowest legitimate price without taking into consideration all factors that should be included has invariably resulted in losses many times the supposed saving. In this connection, I have recently received from one of our state highway officials a letter in which he said: "This is a very important subject and one which has given me much concern in the last two or three years. Right now I am having trouble with a contractor who is altogether irresponsible and was awarded the contract because he was the lowest bidder, but, as it has worked out, it has cost the state a great deal more than it would have if we had awarded the work to the highest bidder at the letting."

Failures in contract performance increase engineering responsibilities and administration expense. The public loses in many ways, all resulting from delay in use of the improvement.

I also believe the failure of the engineer to award the bid to the next bidder where the low bid is not satisfactory but rather to throw out all bids and readvertise is not only uneconomical but unfair.

I am not unmindful of the part which the contractor has alone contributed to present conditions. If the contractor is to expect relief for his industry, he must be fair not only with the public official, the architect, and the engineer, but with the owner and himself. Being fair with himself means that he must be willing to give the same square deal to those with whom he is dealing, including his subcontractors. Unfortunately, we find some contractors who demand the square deal but are not willing to give it. Such a contractor is a detriment to the construction industry, whether in public or in private work.

Another important influence which I believe has contributed to the irresponsibility and inexperience which is so prevalent in the construction industry is the Lien Law, guaranteeing under the surety bond the payment for all materials. I feel that this has frequently resulted in careless selling, and in many cases has been the means of encouraging the inexperienced to enter the construction field without proper finances, and those already in to bid beyond their limitations. I am in sympathy with the protection under the Lien Law for labor, because labor is not in position generally to ascertain the responsibility of the contractor.

One more element responsible for present conditions is the equipment industry, to which I personally belong. Generally speaking, our eagerness for business has developed a careless sales policy involving a lack of intelligent study of the contractor, the contract price, his finances, experience, and conditions surrounding the execution of the contract. It has also resulted in an exceptionally long-time payment contract and overloaded many contractors with equipment, all of which has contributed to the increase of mortality in the construction industry.

I must admit that the motor-truck industry has contributed and is contributing very largely to the present unsatisfactory conditions. It has been instrumental in inducting the irresponsible and inexperienced hauler, who immediately becomes the prey of the unfair and unscrupulous contractor. If the individual hauler is to become a factor of value as a subcontractor, he must have both experience and responsibility. He must receive an adequate compensation not based upon the

price the contractors frequently admit is below what they know is even the cost for the work to be performed. Many hauling contracts have been made with full realization of breaking the subcontractor. I recently heard of a large contract involving an extremely difficult and extensive hauling contract requiring motor-truck equipment. Subcontract bids were received by the contractor and he accepted the low bid. When questioned about the bids by one of the high bidders, the contractor said, "I am aware the low bidder cannot make any money, but it means approximately $10,000 to us and I cannot afford to turn down the bid."

The general contractor was perfectly willing to accept a price that he well knew was unfair and might mean the failure of the subcontractor. Was that the square deal the contractors are demanding?

If the equipment manufacturers are to meet their obligations to the construction industry they must base their sales policy upon conservatism and not greed. The sales policy should not permit the encouragement of new entries into the construction field solely for the purpose of making sales. Every sale of equipment should be based first upon the conservative needs of the contractor, and, second, upon his ability to pay without undue risk.

What Is the Remedy?

I realize that the reader is now asking: What is the remedy? That is a difficult question to answer, but I believe I am able to offer some suggestions. The Associated General Contractors of America were requested by various sources to give a definition of a responsible contractor. Their answer appears in the box below:

The public should demand of public officials, architects, and engineers in both public and private construction careful investigation and consideration of all the qualifications of the builder and not base the award solely on price plus the ability to purchase a bond.

Standard Questionnaires

During the early part of 1924 the Attorney-General of Ohio ruled that it was the duty of a public official to award contracts to the "lowest and best bidders" and that the word "best" must take into consideration all the qualifications of the bidder. To assist in the determination of the qualification of the bidder, the Joint Conference on Construction Practices, consisting of affiliated committees representing the American Association of State Highway Officials, American Institute of Consulting Engineers, American Society of Civil Engineers, American Institute of Architects, American Society of Mechanical Engineers, American Society for Municipal Improvements, Associated General Contractors of America, Highways Industries Exhibitors Association, National Association of Casualty and Surety Agents, Surety Association of America (Committee on Better Underwriting) has prepared and recommends for the uniform use of public officials, engineers, architects, surety companies, and financial institutions, a set of standard questionnaires on finance, experience, and equipment. The uniform use of these forms [published in full in the October and November, 1925, issues of CONTRACTORS' & ENGINEERS' MONTHLY] as standards will materially assist in eliminating the problems of the engineer and architect in dealing with irresponsibility and dishonesty in both public and private construction. Their use will in no way discourage competition. It will assist in changing competition from incompetency and irresponsibility to competency and responsibility. It will invite greater responsibility, skill, and integrity into the construction in-

"The Responsible Contractor

"Whether an individual, firm or corporation, must possess as a minimum of requirement, these essential qualifications as follows:

SKILL

"He must posses the necessary technical knowledge and practical experience, as applied to his particular form or group of undertakings, to enable him to carry them to completion in a workmanlike and economical manner.

INTEGRITY

"He must consistently and persistently comply with the spirit as well as the letter of his contracts. He must have business experience and handle every transaction with fairness and honor.

RESPONSIBILITY

"He must possess cash or credit to meet all his commitments, also the equipment and organization for the satisfactory performance and completion of his undertakings.

"In special cases, problems may appear which will demand that consideration be given to other qualifications, but in general the above three requirements apply to all construction contracts and without them no contractor can properly be regarded as wholly responsible."

dustry, therefore insuring greater economy in performance, and it should materially reduce the losses on surety contract bonds.

In the preliminary report of the committee of the building congress of one of our large cities, we find the following statement:

"It would appear clear that the award of contracts to incompetent contractors is chargeable to owners or their professional advisors, and if the situation is to be improved, the industry must look to the owner, the architect, and the engineer. The use of a standard questionnaire by public officials, engineers, and architects would operate to make clear the contractor's status."

To accomplish all that I have suggested is not only possible, but probable, if all the elements will cooperate.

I would be both unappreciative and negligent if I failed to recognize the very important step toward better conditions in the West by the formation of the "Clearing Bureau of Contract Investigation." Great credit is due to those who have been instrumental in bringing about the movement, and I am sure that under the leadership of men of such recognized ability and integrity satisfactory results may be expected.

In conclusion, let me recommend to all the adoption of the following policy and its consistent practice:

General Public! Don't fail to realize that every man is entitled to a square deal which involves an honest return for his accomplishments.

Architects, Engineers and Public Officials! Don't let a contract unless you know that the successful bidder has the resources to complete it. Don't let a contract at a price below an intelligent estimate of cost, plus a responsible profit, or allow a surety company to bond such a contract.

Surety Companies! Don't bond a contractor unless you know he has the experience, financial resources, and physical equipment necessary to fulfill the contract. Don't bond a contract having an inadequate bid.

Contractors and Subcontractors! Don't bid on contracts for which you do not have the equipment or the resources to handle. Don't undertake any job at an unprofitable price. Build your business upon the same square deal you demand for yourself.

Material Manufacturers and Distributors! Don't base your credit extension on Lien Law protection.

Equipment Manufacturers! Don't sell to irresponsible contractors, and do take precautions not to overload any contractor with equipment he does not need.

ACKNOWLEDGMENT.—From a paper presented at the Contractors' meeting at the All-Western Road Show, San Francisco Calif.

The Causes of Low Prices in Highway Bidding

1. Open competition with wide-spread advertisement of jobs.

2. No bonus for speed.

3. No bonus for workmanship or quality.

4. No bonus for freedom from trouble in conducting the job.

5. Materials furnished by municipality in many cases, thus reducing financing required.

6. No preference on materials due to too generous lien laws and bonding protection to sellers.

7. Natural desire of machinery companies to sell their goods to any one.

8. The number of bonding companies competing for business, some of which will bond anybody. Many of these companies, when in doubt, increase the competition by bringing in new bidders who will bond with them.

10. The gambling tendency of almost all true contractors.

11. Lack of continuous and consistent programs in most areas, leading to a building up of organizations and equipment during the peaks and a wild scramble for the few available jobs during the depressions.

12. General overcrowding of the highway contracting field.

13. General lack of really severe qualification of bidders.

14. The almost universal practice of giving any low bidder a job provided he can furnish a bond.

15. Irresponsible and ignorant-of-cost subcontractors who take details of the work from underbidding contractors at even lower prices.

16. Sales of motor trucks by some truck companies to any one on shoestrings.

17. The energetic, and usually successful, efforts made by most sellers of pavement materials to bring in low bidders on their especial type of pavement whenever several types are in open competition.

8. Constant introduction of new firms, new blood, and new money, and the seeming necessity that most of these new performers get at least one costly lesson before they settle down to normalcy, or pass out.

19. Desire of politically ruled municipalities to make a low price showing on the actual awards, regardless of the final outcome, which can be well covered up.

What Can Be Done to Improve Contract Bond Conditions?

Substance of an Extensive Investigation and Report by the Surety Association of America

FOR several months, contractors, officials of highway departments, engineers, surety underwriters, and other persons interested in contract bonds have been considering numerous questions concerned with such instruments. This work has gone on for the most part through committees created by the several organizations interested. It has been the general consensus of opinion that some of the prevalent contract bond practices as regards principals, sureties, beneficiaries, and other parties thereto, could be changed for the better, and it is hoped that a friendly, frank, and general cooperative discussion and consideration of the whole subject may result in substantial and permanent benefit to all the interests involved.

Are irresponsible contractors bonded oftener than is more or less inevitable?

Contract Bonds Do Not Insure Responsibility

A contract bond does not in practice, and could not possibly from the nature of things, absolutely insure the awarding of contracts only to bidders who are and will continue to be responsible, irrespective of the bond. There are so many reasons why a contractor may ultimately default on a given contract that an underwriter would have to possess superhuman knowledge and skill invariably to foresee all of them. Dishonesty, inexperience, general incompetency, inadequate organization, over-extension, labor union troubles, transportation difficulties, bad weather, defaults of subcontractors, insufficient financial resources—any one of these or some combination of them may render a contractor irresponsible. Underwriters do sometimes issue bonds for contractors who afterwards prove to be unworthy of suretyship. Does this happen in too large a proportion of cases, and, if so, what can be done to reduce the ratio?

The Underwriter's View-Point

In an endeavor to fairly present both sides of the argument regarding bonding conditions in the contracting field, Contractors' & Engineers' Monthly presents this discussion prepared from arguments set forth by the Surety Association of America, which represents virtually all the bonding companies of this country. A study of "Establishing the Responsibility of Contractors," by S. M. Williams, preceding this paper, gives more light on this very important topic.

Not many people, perhaps, outside of the ranks of professional underwriters realize how thoroughly and in what detail applicants for contract bonds are investigated by responsible surety companies. In addition to the comprehensive form which applicants themselves must complete, minute inquiry blanks perfected as a result of years of experience are sent to banks, material-men, former contractees, and other promising sources of information. Mercantile agencies, of course, are consulted freely. While the circumstances are sometimes such as to render thoroughgoing investigations hardly necessary or perhaps impracticable, it is true, generally speaking, that surety underwriters make extraordinary efforts and in the main successful efforts to obtain full information regarding the ability of the given contractor to perform the given contract.

Notwithstanding the utmost effort on the part of underwriters to procure complete and dependable information about contractors and the contract to be bonded, it remains true, not infrequently, that absolute proof of bondability is lacking. The surety companies will be widely condemned, and quite justly so, if they should withhold their credit from every applicant for a contract bond who could not demonstrate beyond any possibility of doubt his ability to perform a given contract. It is one of the few bright spots of humor in a situation otherwise sufficiently serious that while some critics of the surety companies charge them with lax underwriting, numberless individual contractors are all the time up-

Cooperative action all around would help to eliminate the irresponsible bidders.

braiding underwriters for their refusal to issue merited bonds to worthy applicants. All that the underwriter can do in many cases that are neither obviously good nor clearly bad is to collect all the information available, weigh thoroughly all the known and probable facts and then decide as best he can, with conscience as his guide, what under all the circumstances it is wise and fair to do. There is absolutely no inflexible rule for fathoming the responsibility of the contractors and the sufficiency of their bids for particular contracts, because such responsibility and sufficiency are determined by numerous complex and variable elements. Character, education, experience, industry, ability, financial resources, plant facilities, special advantages for particular jobs, a conservative cast of mind or the reverse—all these and many other factors enter into the problem, and underwriters must judge independently for themselves and for the companies that they represent, with a keen sense of responsibility to the several parties affected, the relative value of all these different elements in the given case. Sometimes the decision is easy. In many instances fairness to the contractor, consideration for the beneficiary of the bond, that is, the owner, and regard for the safety of the surety, necessitate prolonged study and finally cloud the issue with doubt.

While the surety company is under an imperative obligation to procure in some way such information as the given case requires, and while difficulty in doing that is no excuse for slipshod underwriting, more cooperation than is sometimes shown by the other party to the bond would much improve conditions. It is undeniable, for example, that many contractors—the majority of them, perhaps—do not welcome with open arms an investigating surety underwriter. They are inclined to take the easy course and to favor with their business the agent or company which is the least insistent upon financial statements and similar disclosures of their affairs. Engineers and bond-approving departments are sometimes unwilling, or for some reason feel unable, to give the surety companies information that would be distinctly helpful to an underwriter. Material-men and supply houses that may greatly desire for reasons of their own to have a certain bond go through, sometimes, it is feared, give an inquiring surety company less information than they really have. Similarly, a banker who may be already heavily involved in a contractor's affairs, and who may be relying more or less for his safety upon a given contract, is not perhaps the best possible source of information for a doubtful underwriter.

Happily, it seems to be true that conditions in this respect are showing distinct improvement, and a far higher degree of cooperation on the part of all the interests involved in contract bonds may be predicted with confidence. The recent action of the contractors, of certain state highway departments, and of other interested bodies, in the matter of uniform questionnaires and financial statements, is a striking case in point and is most significant and gratifying.

Although once in a while early and complete default by a contractor gives painful indication to the contrary, underwriters never bond a man they have reason to believe irresponsible. To do that, they would have to be mentally irresponsible themselves, but it seems fair to assume that they would not, with eyes open, walk into trouble and loss in this manner. Whatever else may be true, certain it is that when an unworthy contractor is bonded, his surety does not know the real situation, but has been deceived in one or more of the multitudinous ways open on every hand. More often than not, the surety company has been misled as to the financial condition of its principal. Sometimes the principal himself has been misled. It often happens that "experienced" contractors and those who are doing a large business are in fact irresponsible though neither they nor their sureties have any idea of such a condition of things. Frequently this is so because the contractors expect to make a profit on their existing contracts and list the latter in their financial statement as assets, whereas in fact the contracts are subsequently completed at a loss and thus turn out to be liabilities. In one well-known case a certain contractor was remarkably successful in subway construction, completing without default something like forty million dollars' worth of subways. Afterward, however, and notwithstanding all this experience, he failed, with unfinished work on hand amounting to several million dollars, and all this work ultimately cost more than the contract price. This conspicuous example of irresponsibility in a high place could be endlessly reinforced with smaller, but otherwise similar instances. Indeed, at a cer-

No surety company willingly or deliberately bonds an irresponsible contractor.

tain stage of every industrial cycle it is the experienced contractor with a lot of work on hand who is most likely, as construction costs rise, to meet staggering financial losses and possibly become utterly irresponsible.

Inexperienced Contractors Must Sometimes Be Bonded

If, therefore, even experienced contractors turn out at times to be irresponsible, it might be contended that contractors without experience, or without experience in the given kind of construction, should be deemed by virtue of this fact undeserving of suretyship, and, in fact, the bonding companies have sometimes been charged with reckless underwriting because they have followed a different rule. Yet it seems clear upon reflection that it would never do for a bonding company to withhold all suretyship from inexperienced contractors, regardless of every other consideration. Experience, after all, is only one of numerous factors concerned with the many-sided question. The adoption by the surety company of so narrow a rule would not only be unfair to contractors, but would, under conditions that frequently arise in practice, work a serious hardship upon the beneficiary of the bond.

Situations often arise where contractors without experience or without much experience must be bonded by some one or the public work simply will not be done. This is so when a state theretofore without good roads becomes ambitious and suddenly adopts a program of road building in the aggregate amount, perhaps, of millions of dollars. Precisely that welcome phenomenon arises every now and then in our progressive communities. The state starts out with a complete highway department, an expert professional highway engineer and elaborate contracts and specifications supposed to represent the very last word in the building of good roads. Highway construction of recent and best types may be an absolutely new industry in the state, and local contractors familiar with the physical characteristics and the labor conditions of the state will probably never in their lives have built a road according to the specifications and requirements now for the first time enforced in the given commonwealth. Outside contractors, on the other hand, who come into the state to bid may be experienced in road building elsewhere, but will presumably know little or nothing about the peculiarities of topography or labor in the new and untried region. The inevitable result is that there is not available for the large operations contemplated a sufficient number of contractors who are successfully experienced in road building and who at the same time have a most desirable, if not quite necessary, knowledge of local conditions. If the roads are to be built at all, the surety companies have no choice but to bond contractors who are inexperienced in one or the other of the two ways mentioned. They would be deemed by most people derelict in a manifest duty and wholly lacking in public spirit if under such conditions they should selfishly withdraw from the state altogether. In fact, they have never done that, but have gone ahead as best they could with the contracting material at hand. Sometimes they have suffered severe losses in the first year or two of such a project, but few fair-minded people would condemn them, under the conditions cited, for the careless bonding of inexperienced contractors.

To determine whether or not a contractor is sufficiently experienced to entitle him to a bond guaranteeing his performance of a given contract calls in many instances for the keenest underwriting judgment. If the surety companies were to adopt a hard and fast rule not to bond a contractor bidding on a road job, for example, unless he could show that he had successfully completed contracts similar in size and character, highway departments would have even greater difficulty than now confronts them in getting their most useful and important work done within the time allotted and the appropriations available.

Many of the contractors who built the existing subways in New York City have either failed or retired and will not bid on the big new program of subway construction soon to be undertaken. New bidders, however, will not be lacking, and many miles of subways will be built by contractors who could never qualify for bonds if subjected to a rigid experience test, yet it may safely be assumed that these people will be bonded, as some of them, at least, ought to be, and that their contracts will be faithfully performed. Their inexperience will prove to be no barrier to success and no greater disadvantage to them than it was to the pioneer builders of the original subways.

Construction costs have risen 125 per cent in the last ten years. During a period of advancing costs the mortality of experienced contractors is so heavy that unless new money and fresh blood were continually filling up the

depleted ranks of contractors, there would soon be nobody left to bond.

Agents' Authority to Issue Contract Bonds Strictly Limited

One of the commonest criticisms of surety company practice is that agents and their field men have authority to issue contract bonds in accordance with their own underwriting judgment, and that they often do so in behalf of unworthy contractors because of their commission interest in the resultant bond. While this criticism is without substantial merit, the current misconception on the point may be easily understood. In the first place, it is true that agents sometimes have authority to write contract bonds without prior reference to their home offices within stated limits in behalf of certain named contractors—principals with whom the given bonding company may have been dealing for years and whom everybody would deem worthy of such suretyship. In the second place, laymen are likely to be deceived in this manner by the fact that the power of attorney issued by the surety company to their local agent is usually unlimited except in amount and is general in its terms as to the kind of obligation covered. In some jurisdictions, the governmental authorities do not permit the companies to insert in their agents' powers of attorney even a limit to the amount of the bond covered thereby. The surety company must ordinarily issue their powers in the form described because bond-approving public officials could hardly be expected even if they had the requisite knowledge to examine every bond narrowly and make sure that it belonged to one of the classes included in the given power. The surety companies, while they are constrained in most cases and, as a matter of practice, do issue their powers in this broad form, do not intend thereby to authorize their agents to write any and all bonds not exceeding in amount the limit named in the power, if there be such limit. On the contrary, the companies make it clear to their agents that the power of attorney as between the company and the agent confers upon the latter no authority whatever and that they are to use the power only in accordance with instructions otherwise given. In fact, these instructions in virtually all cases are most explicit and exacting, and it may be confidently stated that in practice the authority of agents to issue contract bonds in their own discretion is rigidly limited.

Are occasional defaults of contractors a reflection upon the contract bond business?

A third reason why contractors may easily be misled on this point lies in the fact that field men like to have it appear that their authority is large, and sometimes in soliciting the bonds of contractors they are content to let the latter suppose their power to be much greater than it is.

It is obvious that surety companies must have in all the cities and larger towns representatives equipped with issue bonds. If it were necessary to have all such instruments sent to the home offices of the various companies for execution, the consequent delay would be intolerable and the courts, governmental bodies, and business in general would be subjected to enormous inconvenience. In the case of all important places, therefore, the surety companies have issued powers of attorney to employees or agents whereby the latter are authorized to execute bonds in behalf of their respective companies. Certified copies of these powers are filed with the Federal Government in Washington, with local public officials, with clerks of court, and with others. Through this machinery dependable corporate surety bonds are issued daily in vast numbers throughout the country.

While these powers of attorney are general in their nature, the agent or branch office managers in whose favor they are drawn may use them only in accordance with authorizations that are most carefully circumscribed and delineated by the home office of the company. The authority so delegated varies with the importance of the agent's locality, with the character of the bond to be written, and especially with the experience and ability of the given representative. A small-town agent, for example, would have little or no authority, and ordinary cancellable fidelity bonds would be issued by an agent who might have no authority whatsoever, or very little authority, to issue contract bonds; an old and tested agent well versed in the surety business may be empowered by his company to write many kinds of bonds within designated amounts in accordance with his own underwriting judgment.

The letter of instructions issued to agents in connection with their powers of attorney is a formidable and complicated document and covers all the numerous types of bonds written by the company. Confining our attention to contract bonds, it is generally true that no surety company gives much general authority

to its agents in the contract division of the business. It is probably true that a large majority of the agents of all companies in the business have no contract bond authority whatever and any applications for contract bonds received by them would have to be referred to the home office of the company or to some branch office or general agency having jurisdiction in the given territory. Some agents are authorized to write contract bonds on their own discretion up to five or ten thousand dollars, say; twenty-five thousand dollars would be a high figure, and only a very few agents, and those few widely and successfully experienced, would ever be given by any company general contract authority exceeding twenty-five thousand dollars.

While the Committee of the Surety Association of America which has been investigating and studying the entire problem of contract bond conditions is satisfied that the foregoing statement of the case is accurate, it is necessary and fair to admit that things have occurred in the past in connection with bid and contract bonds that seem inconsistent with the foregoing. The premium income of the surety companies during 1924 was about $83,000,000, and a large part of that income was derived from contract bonds. The aggregate amount of contract so protected by corporate suretyship could not readily be determined with absolute accuracy, but it was undoubtedly enormous—billions of dollars. Several hundred thousand agents had a hand in all this. In the case of a business of such magnitude and complexity necessarily contracted in every corner of the land and conducted to an enormous extent through distant agents, it would be nothing less than a miracle if abuses of underwriting authority on the part of agents should be altogether absent. Conditions in this respect are improving. While the competition of surety companies for contract bonds has always been and continues to be of the keenest character, they are not eager for it at the expense of safety, and sad experience has shown them that contract bonds and underwriting cannot be prudently left to field men. Agents are not now permitted—even large producers of desirable business—to violate their underwriting instructions, and repeated instances of that nature inevitably lead to the revocation of all authority or in a flagrant case to an outright forfeiture of the agency.

Originally no bonds of any kind were required, resulting in staggering losses.

It seems to be considered in some quarters that a bond covering a certain contract unconditionally guarantees that the contract will be performed, and it is further considered that the surety company, in case the contract for some reason is not in fact performed, has somehow failed in its duty to the public and is chargeable with either bad faith or inefficiency. The people who hold this opinion would never think of making the same statement in analagous cases. They know perfectly well that a fire insurance policy does not guarantee that there will be no fire, that a burglary policy does not insure the absence of midnight intruders, that a bond covering a state treasurer does not mean that the official will in no conceivable circumstances become a defaulter. Similarly, contract bonds do not and could not possibly insure beyond all peradventure the absolute performance of the contract covered. Everybody knows that contractors have always defaulted at times and that no system of bonding could possibly bring such default to an absolute end—no system at least that would for a moment be workable.

The view referred to above proceeds from a misapprehension of the essential character of a bond. When a company becomes surety for a bank cashier it does not in the least pledge its word and its capital that the cashier will never steal, but only that if he does steal they will indemnify the bank for any loss so caused. Not only fidelity bonds of the type cited, but all bonds, are in their essence instruments of indemnity, and contract bonds must be so regarded if one would draw sound conclusions concerning the rights of the parties in case of contract defaults. What the beneficiary of a contract bond has a right to expect at the hands of the surety company is not the performance of the given contract by the principal on the bond, but indemnification for nonperformance by him. In practice, of course, it usually happens that the surety company steps in and completes the work as the easiest and most satisfactory way of fulfilling its obligation to indemnify; but the condition of the bond would be satisfied if that were not done, —as, indeed, it sometimes is not, at the owner's request,—and if the surety merely paid in money to the beneficiary whatever loss the latter sustained by reason of the default.

A glance at the history of suretyship in public work may clarify the point. No bonds of any kind were originally required, and public officials awarded contracts to their favorites, or

at least in accordance with their own judgment or desires. The results were such as might have been expected, and thousands and thousands of dollars were lost through the failure of contractors. Then laws were enacted providing for the awarding of contracts to the lowest bidders and requiring the latter to give bonds for the faithful performance of their contract. When these bonds were first required, corporate suretyship was not available and individuals went on the bonds as a friendly accommodation to the contractors. This system of personal bonding was in general practice up to thirty years or so ago, and it is still in use in many places. These personal bondsmen might, and probably do, show bad judgment in becoming surety for contractors who prove to be irresponsible, but they were regarded as deserving sympathy under such conditions and they were not subjected to criticism merely because they bonded a contractor who lacked experience, equipment, or finances.

In the later years of the 19th century surety companies came into being and it was quickly seen that corporate suretyship constituted a vast improvement over the system of personal suretyship theretofore in force. This change in the character of the surety has not altered in any respect the nature of the transaction as a whole. It is still suretyship pure and simple. In some discussions of corporate bonds, the implication is that they impose on the surety companies obligations separate and distinct from, and additional to, those assumed by the contractor. Nothing of that sort is consistent with the fundamental idea of suretyship. Corporate bonds did not originally, as nowadays they commonly do, cover the payment of labor and material bills, as well as the performance of the contract, and they have been otherwise in some cases enlarged in scope, for the greater convenience and safety of the public, but they have not changed in essential character. Contract bonds are to-day, as they have always been, agreements to indemnify for losses caused by defaulting principals, not original and absolute undertakings to do things irrespective of defaults.

The real nature of a contract bond is a promise to indemnify the beneficiary from loss.

A contract bond is a non-cancellable financial guarantee, standing between the owner and a possible increase in cost. It guarantees that the contractor will fulfill all the obligations assumed by him under the contract. It is a form of credit, because it increases the contractor's financial strength for the benefit of the owner as regards the work bonded by an amount equal to the penal sum of the bond.

Thus far this discussion has referred only to fundamental principles, because they seem to be ignored in a good deal of the current discussions of contract bonds, but it does not follow that the surety companies have any desire or purpose to evade either the letter or the spirit of agreements with the public as embodied in their bonds. They realize that contract defaults, even when indemnified, are on all accounts regrettable. The surety companies are bound under their agreements to put the bonded contracts through themselves if necessary, to replace defective parts, to repair sub-standard work, or otherwise to indemnify the beneficiaries of their bonds for the non-performance of their principal's contract, for they know full well that contract failures under some conditions are in practice hardly compensatable and they realize that the public interests are in any event better served by the faithful performance of the contract than by indemnification for incomplete performance. Keenly aware of all this, the surety companies are most anxious to do all they can to bond none but worthy and responsible contractors.

Under present-day conditions surety companies are issuing bonds of vast variety and number to various classes of the public, and claims under these bonds are being paid all the time to the beneficiaries. Such payments aggregate large amounts. Such payments or their equivalent in the shape of losses sustained by the surety companies in making good their indemnification agreement in 1924, for example, amounted to $34,422,213. While the ability and determination of the surety companies thus to meet their obligations is presumably understood and admitted by those who in the past have profited directly in this way from corporate bonds, critics of the companies occasionally claim that the agreements embodied in corporate bonds are not carried out in good faith by the sureties.

Not always is the adjustment of bond claims a simple matter. When a man whose life has been insured dies, the claim under the life policy, with very rare exceptions, is provable and payable almost at once, and a similar situation exists with many other classes of insurance. Sometimes bond claims may be settled with like facility, but no such summary procedure is practicable in the case of certain

classes of bonds and under conditions that continually arise in practice. Claims accruing from contract bonds, for example, obviously involve factors far more numerous and more complicated than those incident to an ordinary death-claim under a life insurance policy. Bonds, moreover, are three-party instruments, and the surety companies not infrequently find that claims are made such that they cannot meet the demand of one of the other two parties without violating the rights of the third party and under such conditions no prudent or safe course is open to them except to await a judicial determination of the issue or a friendly agreement of the parties. Such situations are much regretted by surety companies and are averted by them whenever possible.

Proposed Substitutes for Corporate Surety Bonds

There are many obstacles in the way of substituting the deposit of negotiable securities in lieu of corporate surety bonds. The surety companies naturally believe in corporate contract bonds. They are convinced that such instruments serve a most useful purpose in the economic life of the nation, and they believe that no adequate substitute for them is available. They suppose it to be generally admitted that personal sureties, even though the latter are still functioning in some places, are not comparable with corporate sureties in the matter of public convenience and safety. This is true particularly of contract bonds, as comes out so clearly in the event of contract default. Bonding companies know that it pays to anticipate and run toward trouble instead of waiting to be overtaken by it. They minimize their losses by taking prompt action and lending their financial strength to a weak contractor. They have learned how wise it is to do all this quickly and keep the job moving to completion. The personal surety, on the other hand, has no organization equipped to investigate the difficulty and decide at once on remedial measures. Whatever the shortcomings of the surety companies may be or may be thought to be, few owners could be found who would not vastly prefer to have a corporate rather than a personal surety when the hour of default arrives.

It has often been suggested that corporate bonds might be advantageously replaced with a system whereby contractors could deposit negotiable securities with the owners. In the first place, it is thought that comparatively few contractors are overburdened with negotiable securities, so that in practice the plan would be rarely workable except with the largest contracting organizations, but, even if it were, there are objections. Such a deposit would deprive the contractor of working capital and correspondingly lessen his ability to finance his operations. Unlike a corporate surety bond, the deposit does not improve the contractor's financial position with the owner, because any securities deposited already belong to the contractor, and his full financial strength bulwarks his signature to the contract. A contract bond, on the other hand, directly increases the financial resources of the contractor for the sole benefit of the owner by the penal sum of the bond, and this amount stands between the owner and a possible increase in cost of the work bonded.

It is important for an owner or governmental unit to remember when accepting negotiable securities for contractors in lieu of a bond that the owner will thereafter touch such securities at his peril. If, in case of default, he avails himself of any part of them, he thereby assumes complete responsibility for every dollar so used. The owner and his attorney in any such contingency will have their troubles, such as are experienced by the claim department of surety companies in determining which of the unpaid claims to pay and which to reject, which personal injury and property damage, if any, to recognize, and so on. Whatever is done is subject to the approval of the depositing contractor, who will not hesitate to sue them for any amount that he thinks may have been improperly expended.

Similarly, again, there is a third substitute sometimes urged for corporate bonds, namely, the retention of a certified check by the owner until the contract is completed and all danger of liens is passed. This check would naturally be of the same amount as an ordinary bond. In that case, the contractor is likely to be even more cramped financially than if he deposits securities. What was said in the paragraph above about the danger the owner runs when he uses securities deposited by a contractor, applies equally, of course, to the situation just mentioned.

Occasionally it is suggested that the customary bond be waived and that the owner protect himself by retaining a large proportion of the contract price, from 20 per cent to 25 per cent perhaps, until the work is completed free of liens. This procedure is open to both the objections cited above. It does not increase the contractor's financial strength, but, on the

contrary, cripples it, and in the event of trouble the owner finds himself trapped in legal and pecuniary entanglements.

The Rate for Contract Bonds

It is often asked why the rate for contract bonds is based on the amount of the contract rather than on the amount of the bond. Because the amount of the contract measures, better than anything else, the hazard of the given risk to the surety company. Bonds are commonly called for in an amount varying from 25 per cent to 50 per cent of the contract price. In practice, generally speaking, it does not matter much to the surety company what the percentage is, assuming that a 25 per cent bond at least will be required, because it is not expected that the loss in any event will be 100 per cent, 75 per cent, 50 per cent, or anything like such proportions of the contract price. If the defaulted contract has to be relet by the bonding company or if it is completed by the company, the loss to the surety in either case would ordinarily fall within 25 per cent of the contract price. It has long been the practice of companies, therefore, to base the premium rate on the contract price, and the amount of bond is used for that purpose only when, as rarely happens, the contract price is five times or more the amount of the bond.

Another question has frequently been asked, namely, "Why must contractors who have been long in the business and are abundantly responsible pay the same rate as bidders who are relatively inexperienced and whose financial standing is open to doubt?" This question is quite understandable and the apparent inconsistency would not be easy to explain completely without inflicting the reader with a lengthy dissertation upon the theory of suretyship and the science of contract underwriting. The answer is twofold:

In the first place, both the relatively strong and the relatively weak contractor are regarded by the underwriter as abundantly responsible with reference to the given contract. Otherwise the bond would not be issued. In theory they are always so regarded, and in practice they are almost always found to be so. No underwriter would deliberately accept a risk when a contractor seems at all likely to default, so that in theory at least there is no difference from the standpoint of suretyship between the large contractor and the small one. If it be assumed that both contractors would be able in any event to complete the contract or indemnify the owner, there is no reason why one should pay a less premium for his bond than the other.

Moreover, it would not be practicable to make sliding scale rates based upon the comparative responsibility of contractors or the underwriter's idea of such responsibility. The surety companies would be in hot water all the time over the point—with agents, contractors, owners, and everybody else. It may relevantly be added, perhaps, that the bonding companies have suffered severe losses in the past from contractors who would have received a highly favorable rating if the plan under discussion had been in force. While the granting of uniform rates to contractors of different degrees of responsibility may not be easy to understand at first, the impracticability of the alternative plan would be apparent to people endowed with the eminent good sense characteristic of the average contractor.

An incidental objection to the sliding scale rating method may be found in the fact that it would automatically inject an element of inequality among competitive bidders in all lettings.

The Proper Way to Start a Gasoline Engine

IT has been found by some manufacturers that many operators of heavy-duty gasoline engines do not know the most efficient method of starting the engine they are operating. To overcome this, the Climax Engineering Company, Clifton, Iowa, has issued some specific information:

"Retard the spark by pulling the magneto breaker housing lever up as far as it will go. Set the impulse starter on the magneto unless it is automatic. If the engine has been standing more than a few minutes, pour a small quantity of gasoline through the priming cups in each cylinder. Set the choker of the carburetor about three-quarters closed. Throw out the engine clutch if it is fitted with one. If your engine is equipped with a starter, press the starting switch lever just long enough to get the first explosion of the engine. Release lever immediately upon the engine starting. Open carburetor choke and advance the spark by pushing the magneto breaker housing lever down. Allow the engine to run idle until warmed up before applying load. If the engine does not start immediately, do not let the starting motor continue to turn over the engine. Using the starting motor for more than a few seconds continuously will damage the windings and will run down the storage battery very quickly. When using the starting crank to start the engine, crank the engine with retarded spark and choke set three-quarters closed. Pull up on the crank handle. Do not push down the starting crank. It is dangerous."

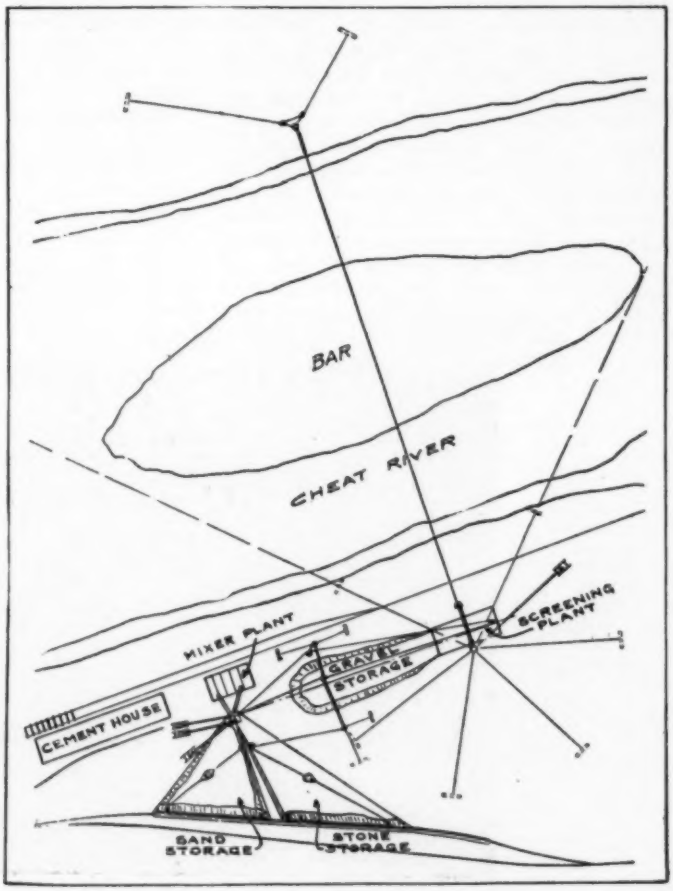
Economical Method of Handling Aggregate for Concrete Dam

Unique System Devised for Concrete Dam and Power-House Contract

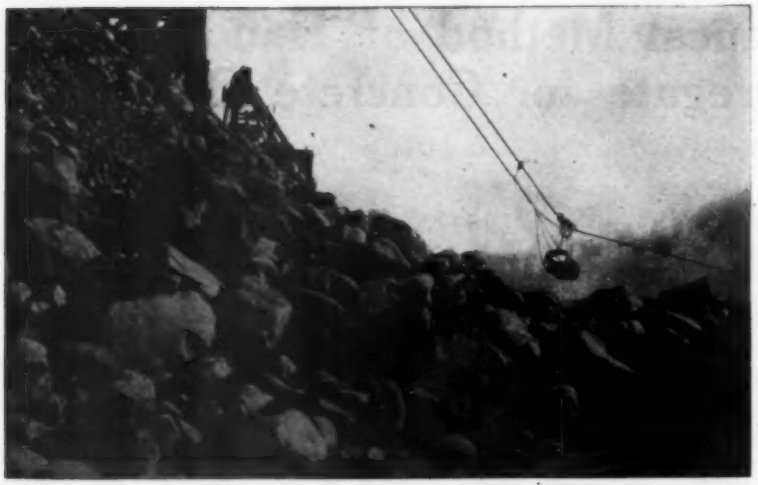
IN constructing a concrete dam and power house for the West Virginia Power and Transmission Company on the Cheat River just south of the Pennsylvania state boundary, Sanderson and Porter, engineers and contractors, New York City, employed a particularly effective scheme for handling concrete aggregates.

Concreting was started early in June, 1925, and, in order to complete this part of the work before winter set in, it was necessary to pour 25,000 cubic yards of concrete a month. Maintenance of a steady flow of aggregates to the central mixing plant was essential to the success of this program. The method used by Sanderson and Porter functioned so successfully and at such low cost that it is worthy of a special description, particularly as it is applicable to other concrete dam construction work where similar conditions prevail.

When the advance forces of Sanderson and Porter arrived on the scene in February, one of their tasks was to test a bar of gravel in the river as a possible source of concrete material. Finding that this bar could supply all the gravel required, the company engineers set to work to devise the most economical arrangement of equipment for producing



LAYOUT OF SANDERSON AND PORTER'S CABLEWAY INSTALLATION ON THE CHEAT RIVER



PILE OF REJECTS SHOWS SIZE OF BOULDERS HANDLED BY CABLEWAY

the gravel and conveying it and other aggregates to the central mixing plant. They decided on a layout which included a screening, crushing, and washing plant located on the bank of the river about 300 feet from the central mixing plant, as shown in the diagram. To serve this, an 800-foot span, 2-cubic-yard Sauerman dragline cableway was installed to excavate and deliver the raw material to the screens. A 1½-cubic-yard Sauerman power drag scraper system was installed to operate over the ground between the screening plant and the mixing plant, to drag the finished gravel either onto a temporary storage pile or direct to the receiving hopper at the foot of the mixing plant.

An unloading trestle was built to receive cars of sand and stone and was placed several hundred feet back from the river so as to allow ample ground space between the trestle and the mixing plant for storage purposes.

Two Sauerman power drag scraper systems were installed to stock out the materials dumped from the trestle and reclaim these materials to the hopper of the mixing plant as required; one system, equipped with a 1-cubic-yard Crescent scraper, was used for the stone, and the other, equipped with a ¾-yard

THE 1-YARD SCRAPER STOCKING OUT STONE FROM THE TRESTLE

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Crescent, for the sand. Each scraper had a separate triangular area of ground within its radius of operation.

Concrete Costs Ran Low

This plan of handling the aggregate has given the utmost satisfaction and unquestionably was responsible for the fact that the cost of the concrete ran unusually low on this job. In November, when the completion of the concreting was in sight, the 1½-yard Crescent scraper had handled about 65,000 cubic yards of gravel, the 1-yard scraper about 45,000 cubic yards of stone, and the ¾-yard scraper about 52,000 cubic yards of sand. The storing and reclaiming of this volume of material had been accomplished smoothly and economically with a force of 6 men—an operator and a laborer for each scraper at a cost of $12 per day. The exact expense for power and up-keep could not be ascertained, as the power bills and repair items for the scraper systems and mixing plants were all lumped into one account. H. L. Myer, the Superintendent, expressed a belief that the scrapers had handled the storing and reclaiming at less cost than would have been possible with any other type of equipment.

Separate records have been kept of the expenses connected with operating the Sauerman cableway and gravel plant, and it was found that 65,000 cubic yards of finished material had been placed at a cost of 20 cents per cubic yard. This 65,000 cubic yards does not by any means represent the total yardage handled by the cableway, as the excavated material contained many large boulders and shale, also a considerable percentage of sand that had to be discarded. Probably the cableway handled close to 100,000 cubic yards out of the river and will handle another 60,000 cubic yards at a new set-up in digging a tail race for the dam.

The Screening Plant

The screening plant was a high timber structure without bins. The separation and scrubbing equipment was designed primarily to eliminate the shale which was present both in large pieces and in fine particles, the latter making necessary the wasting of all sand that passed through the plant. The material that came through the fine scrubber consisted of clean 3/8-inch to 10-inch gravel. A crusher took care of all the material over 3 inches, and the finished product was spouted onto the ground in the path of the large Crescent scraper.

Storing and Reclaiming

The scheme of storing and reclaiming with the three scrapers, is also interesting. While one scraper was engaged in conveying one form of aggregate to the hopper of the mixing plant, the other two scrapers were busy building up storage piles of their respective aggregates. Naturally, the storage piles soon reached right up to the mixing plant, making reclaiming very easy. Two continuous bucket elevators lifted the material from the ground hopper to the top of the mixing plant. This plant was built around two 2-yard mixers with the bins above the mixers divided into two compartments for sand, two for gravel, and one for stone, the idea being to use gravel concrete for the interior of the dam and limestone concrete for the outside. Each compartment had a batcher for measuring the material into the batch hoppers. A belt conveyor brought the bags of cement up to the charging floor from the cement house. Each mixer turned out, on an average, 20 batches an hour.

The placing of the concrete in the forms was a problem in itself, for the mixing plant was located about ¼-mile up-stream from the dam. It was impossible to set the plant any closer to the construction work, because the valley was extremely narrow at the actual site of the dam. The transportation of the mixed concrete to the job was managed successfully by using four trains of flat cars, each train made up of two cars, and each car carried two concrete buckets. The mixers discharged directly into these buckets. Two steel guy dericks were employed at the dam to swing the buckets off the cars and into place. The buckets were dumped by hand.

The dam is about 1,000 feet long, 140 feet wide between the aprons, and 135 feet high. An earlier effort to build a dam at this point was abandoned in 1913, the interests behind the project at that time becoming discouraged after working for a year.

JOB LAYOUTS

One of the most interesting features of construction work is the wide variety of ways in which equipment may be arranged on jobs to efficiently handle the work. If you have a layout that was particularly effective, make a sketch of the ground plan, briefly describe the job in a letter listing the equipment, and send it to CONTRACTORS' & ENGINEERS' MONTHLY for publication.

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Legal Points for Contractors

These brief abstracts of court decisions in the contracting fields may aid you in avoiding legal difficulties. Local ordinances or state laws may alter the conditions in your community. If in doubt, consult your own lawyer

Edited by A. L. H. Street Attorney-at-Law

When Workmen's Compensation Act Applies

Under the Connecticut Workmen's Compensation Act, as under similar laws in some of the other states, an employer's status as being subject to the provisions of the act depends upon the employment of a certain number of persons—in Connecticut, five. The Supreme Court of Errors of that state was lately called upon to determine what the employer's position is under the law where the number of his employees varies: ranging from fewer to more employees than the number required to make the act applicable. (Sorrentino vs. Cersosimo, 130 Atlantic Reporter, 672.)

Disposing of the question, the Court ruled that neither the average daily number of employees, existence of a definite quota or standard number, nor total number entering and leaving the employment during the period involved governs, but the size of the group employed throughout that period.

Liability for Injury Caused by Material in Street

The Georgia Court of Appeals appears to have gone the full limit of law and reason in upholding judgment against a municipal contractor on account of injury sustained by a boy who fell off a bicycle when it struck a pile of sand in a street undergoing repairs. (Mewborn vs. MacDougald Construction Company, 129 Southeastern Reporter, 917.) It was decided that the facts that the material "could have been seen" and that the boy knew of the condition of the street and the location of material thereon did not necessarily relieve the contractor from liability for failing to have the pile marked by a light. The Court said:

"The plaintiff might have had a general knowledge of the condition of the street and of the presence and location of the paving material, acquired in the daytime, and yet need a warning or reminder when coming within the vicinity thereof in the nighttime. A light may have been necessary to guide him safely by an obstruction which he remembered to exist at a certain place, because otherwise he might not be able in the nighttime to locate the place."

Validity of Contract Limiting Use of Materials

In the case of Delmas vs. Gano (105 Southern Reporter, 535), decided by the Mississippi Supreme Court, it appeared that plaintiff sold defendant 30,000 barrels of a certain brand of cement to be used by the latter in performing road construction contracts. A clause provided that if the defendant should "sell or otherwise dispose of any portion of said cement or use any portion thereof in any other work than that described," plaintiff seller might decline to make further deliveries under the contract. In an action on the contract, defendant claimed that the agreement was invalid as being in restraint of trade and therefore violative of the anti-trust law. The Court, however, sustained the agreement, holding that the restraint of trade was not unreasonable, especially since plaintiff had no monopoly in the sale of cement.

Loss of Right to Claim Extra Compensation

What the New Jersey Court of Errors and Appeals lately decided concerning the right of a contractor for the construction of curbing and guttering for a village (Overland Construction Company vs. Village of Ridgewood, 130 Atlantic Reporter, 559) applies with equal force to similar conditions arising under private construction contracts.

The plaintiff unsuccessfully sued for extra compensation under the following stated facts: The company claimed that it was directed by the municipality's agents to proceed with the work under weather conditions which normally would and actually did spoil part of it. This part was rejected by the supervising engineer, and the company did it over again, in order to secure a certificate and payment. The Court said:

"The claim made in this suit necessarily rests upon the proposition that the payments made under the contract and upon the engineer's certificates were payments *pro tanto* for the spoiled gutters and curbs first laid, and that, although plaintiff felt obliged, or deemed it proper under the circumstances, to do the work over again in order to obtain the money, it can now treat the payments as made for spoiled work and recover for the further work as extra. But in our view, plaintiff is manifestly barred by fundamental rules of estoppel. When it laid the curbs and gutters, part of which were defective, and claimed payment, it was either entitled to a certificate and payment, or it was not. If not, of course, that ends the case. If it was, and the engineer wrongfully and illegally refused a certificate, that was the time to assert its rights, to refuse to do the work over again, and to raise the issues now raised in this case, including agency of the officials and the like. Plaintiff chose not to do this, and submitted to the requirements that the work be partly torn out and relaid as a condition of payment. It cannot now, after the village has been led into paying its money on the express basis of accepting, not the original defective work, but the proper new work, as performance of the contract, take a position precisely opposite to that assumed by it in receiving payment under the certificates."

Wide Experience

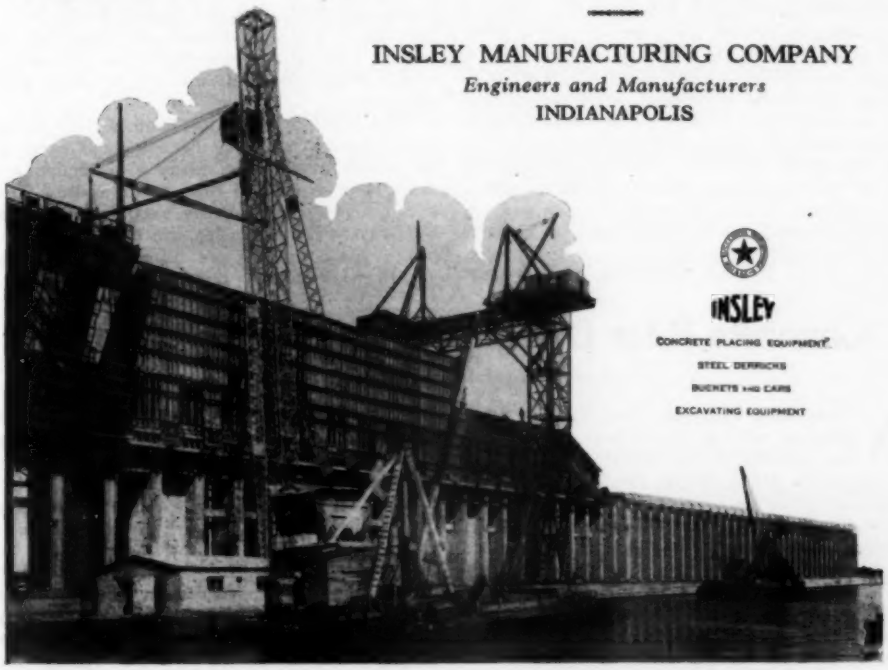
DURING the past two years Foley Brothers-Peppard & Fulton have constructed two large concrete ore docks, one at Ashland and the other at Superior, both in Wisconsin. All concrete on both docks was handled by the same INSLEY STEEL TOWER BOOM and COUNTERWEIGHT PLANT. The job shown is the Northern Pacific Railway Ore Dock extension at Superior. This addition is 660 feet long, 70 feet wide and 80 feet high.

The 140-foot Steel Tower Plant is mounted on a barge, and supported by stifflegs. The mixing, hoisting and proportioning plant are all on the same barge, and the entire plant can be floated into any position desired. With this plant a daily average of 500 cubic yards per ten-hour day was maintained throughout the job. All concrete was placed in the forms by means of the forty-foot boom and counterweight chutes.

This plant is as far removed from the needs of the average contractor as this ore dock job is removed from his construction experience. And the same organization of Insley Engineers is equally at home in providing means of handling concrete on the average job as it is in providing ways to solve the concrete placing problems of such specialists as Foley Brothers-Peppard & Fulton.

Whether your concrete job is large or small, whether it is a garage, bridge, dam or ore dock, *there is an Insley Concrete Handling Plant to help you handle it economically.* And this plant is backed by the wide experience of Insley Engineers and the Insley reputation for honest value and leadership in its field.

INSLEY MANUFACTURING COMPANY
Engineers and Manufacturers
INDIANAPOLIS



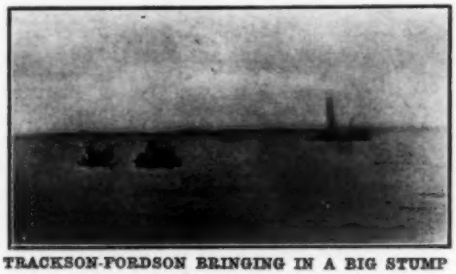
Building a Summer Resort Out of a Reservoir

Interesting Development at Grand Reservoir, Between St. Marys and Celina, Ohio

AN interesting piece of development is going on between St. Marys and Celina in the western part of Ohio, where a summer resort is being built out of the former Government reservoir known as Grand Reservoir. Public and private capital is being spent on the artificial lake, now known as Lake St. Marys, which has been almost forgotten for thirty years. At both ends of the lake are amusement parks, and in between are nine subdivisions. The largest and most modern of these subdivisions is Northwood, on the north shore of the lake, composed of a wooded tract 200 acres in area with winding driveways.

Lake St. Marys was originally a swamp open at both ends. In 1837 work was started to convert it into a head of water to supply the Miami and Erie Canal, which runs from Cincinnati to Toledo. By the use of teams, wheelbarrows and scrapers, banks 20 feet high and 5 miles in length were thrown up, open on both ends, making a lake approximately 3 miles wide and 9 miles long, with a total area of 17,540 acres under water. It was completed in 1845, and was used to supply the canal running north.

In order to convert this reservoir into a summer playground, it was necessary to clean out and reopen the channel through the lake. The locks which govern the water-level were opened and the surface dropped 5 feet. As the water receded, scores of stumps appeared above the surface. To get the stumps out was a considerable problem, as the water was too shallow for large scows, and the muck on the bottom of the lake was too soft for horses. This was overcome by hooking the stump near the shore to a Fordson tractor equipped with Trackson Full-Crawlers, and pulling them up onto the shore. The broad steel tracks and light ground pressure of only 2¼ pounds per square inch on the tractor crawlers, kept the Fordsons from miring. The real difficulty was with the stumps located at some distance from shore where the water was deeper than the elevation of the Fordson carburetor. To take care of these stumps a large drum containing a thousand feet of steel cable was bolted to the rear of the tractor. The Fordson went out into the lake until the water was up to the ignition system, and then a motor-boat carried the end of the cable to the stump beyond, hooking it to the stump. Thus, at a comparatively low cost, stumps within several hundred yards of the shore were pulled out.



TRACKSON-FORDSON BRINGING IN A BIG STUMP

Other similarly equipped tractors with scoops were used for removing the muck and weeds at the bottom of the lake, where a swimming and diving pool is planned close to the shore. Two inlet channels approximately 2,000 feet long, 100 feet wide, and 8 feet deep, are being cut in this tract. Fresno scoops are being used with the Trackson-Fordsons on this work.

Concrete Piles Driven 24 Hours After Casting

Tests of Unusual Interest in Many Fields

AN interesting test, which may prove of great value in reinforced concrete pile foundation construction, has recently been reported by Harlan D. Miller, Bridge Engineer, California Highway Department, in the *Pacific Street and Road Builder*. This test was undertaken by the Bridge Department of the Highway Department at Pismo, San Luis Obispo County, where two state highway bridges are under construction. A concrete test pile was cast, using Lumnite cement instead of ordinary portland cement. Twenty-four hours after the pile was cast it was driven 45 feet in the ground to refusal. The test was one of the first made by the California Highway Commission with this special cement.

In this instance, Lumnite cement seems to have developed after 24 hours a greater strength than most portland cements at 28 days. It requires about the usual time to set, but after setting, Lumnite develops maximum strength very rapidly. One of its principal raw materials is aluminum ore.

It was not possible to make a strength test of the concrete used in the pile at the age of 24 hours, but two 6- x 12-inch sample cylinders of the concrete were tested within 48 hours after casting. The 200,000-pound state testing machine did not break either of the test samples, indicating a strength in excess of 5,600 pounds per square inch. This test concrete after 48 hours

Ransome 7-S Standard Building Mixer. Beacon Construction Co., Boston, Mass.

You'd say the same

"It's the only 7-S on the market that hasn't an "out" somewhere about it."

Another way of putting the same thing is to say that no 7-S Mixer except a Ransome offers 19 distinct, definite construction features that constitute mixer value.

Send for free bulletin.

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Ransome Building Mixers

had a strength at least equal to ordinary portland cement concrete at the age of three months.

A No. 1 Vulcan steam hammer was used to drive the test pile, which was 47 feet long and 18 inches square. The usual time of curing before driving concrete piles is 28 days, but the pile used at Pismo was driven exactly 24 hours after casting it. It required 643 blows of the hammer to drive the pile 25 feet in the ground to refusal. The pile was apparently not injured in any way by the rough treatment to which it was subjected, except that under the blows of the hammer there was a little spalling at the top.

Value of the Test

The value of a test of this kind is obvious. In the future, whenever concrete piling is to be used in construction of bridges or other structures, a test concrete pile can be driven on short notice, and exact conditions determined upon. This is not always possible with wooden test piles, which are generally used to obviate waiting 28 days for a concrete pile to cure. Wooden test piles are sometimes unsatisfactory because of the difference in size and penetrating power. The driving of such a test pile frequently gives the wrong impression, and concrete foundation piles are cast an improper length as a result, causing loss of time and investment.

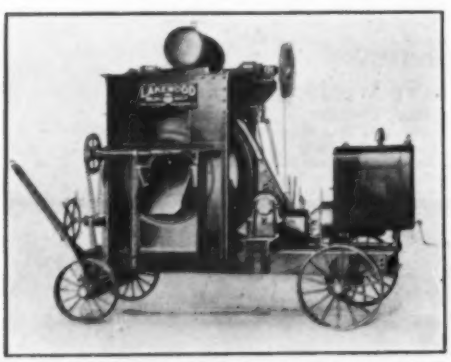
The use of a concrete pile as a test pile is a true guide for determining the proper length for other concrete piles. This experiment of the California Bridge Department may be the means of effecting a considerable saving in the future.

Worm Speed Reduction on Building Mixers

Adaptation Eliminates Gears, Chains, and Sprockets

FOR the first time in the history of concrete mixer design the principal driving mechanism has been completely enclosed in an air-tight housing by the Lakewood Engineering Company, Cleveland, Ohio. The driving mechanism is mounted on big ball bearings and runs in oil. This is accomplished by using a worm speed reduction instead of the usual gears and shafts or chains and sprockets to reduce the engine speed to the speed of the drum. Not only are fewer parts required, but wear on the worm is practically negligible. There is also freedom from noise and vibration, which is new to concrete mixers, which usually are rather noisy outfits because of their bulk and power.

The Lakewood worm reduction is a heat-treated steel worm directly connected to the engine shaft through a universal coupling. It drives a bronze worm gear which is mounted on the drum pinion shaft. Through this one unit the speed of the engine crank-shaft is reduced to the proper speed for the drum. Four big Gurney bearings are used in the worm reduction, two for the worm shaft and two for the worm gear shaft. The entire unit is mounted in a heavy air-tight housing and runs in oil.



THE WORM-GEAR-DRIVEN LAKEWOOD 14-S TILTING MIXER

From an operating standpoint, according to the Lakewood Company, the use of the worm reduction gives several advantages heretofore impossible to secure. The radiator is faced directly away from the drum. The crank of the motor is hung over one end of the frame. Both sides of the motor are easy to reach from either side. Changing from gas to electric power is simplified. The change is made using the same drive-shaft with a universal coupling bored to fit the shaft of the motor, and the power-take-off is based on 1,200 r. p. m. for either gas or electric power; no change in the speed reduction is necessary. From the safety standpoint, the use of the worm reduction is a distinctive improvement. The only gears required are the drum gear and the pinion, and these are covered with a steel guard. The drive-shafts from motor to worm and from worm gear to pinion are also covered, as is the power loader mechanism. The entire power loader mechanism, consisting of flexible couplings, hoist drum, brake, clutch and knockout, is in a self-contained frame easily removed or attached.

Other new developments have been made in these mixers, according to the manufacturers. Self-aligning bronze bearings are now used throughout, with Alemite lubrication. The pivoted power loader is used, having a discharge angle of 50 degrees. Each drum roller shaft is held in self-aligning bronze bearings and cast steel boxes. Loosening four bolts causes the shaft to drop clear of the frame without interfering with other parts of the Lakewood mixer. The Lakewood 7-S and 14-S building mixers are now equipped with the worm speed reduction.

Ruggles Road Builders include a complete range of sizes and types for every dump body need in 1½, 1⅔, 2 and 2½ yard capacities.

Built on Experience!

One of the reasons why Ruggles Road Builders have so consistently outperformed other trucks in road construction work is because Ruggles engineers have constantly studied operating conditions and met the needs of contractors and material haulers with special designs which assure complete satisfaction in this exacting service.

Ruggles Road Builders are not merely standard truck models with a short wheelbase and equipped with dump bodies, but have been designed and developed throughout for the unusual requirements of road building.

That is why Ruggles Road Builders get in and out of gravel pits and soft ground with greatest ease, turn around in smallest places, deliver more trips per day, attain greater speed as well as greater power and stand up with unfailing dependability at a minimum cost of operation.

On many of the largest construction contracts Ruggles Road Builders have enabled contractors to break all records. Send for facts which conclusively prove the many advantages of Ruggles ownership.

Ruggles Motor Truck Company, Saginaw, Michigan, U.S.A.

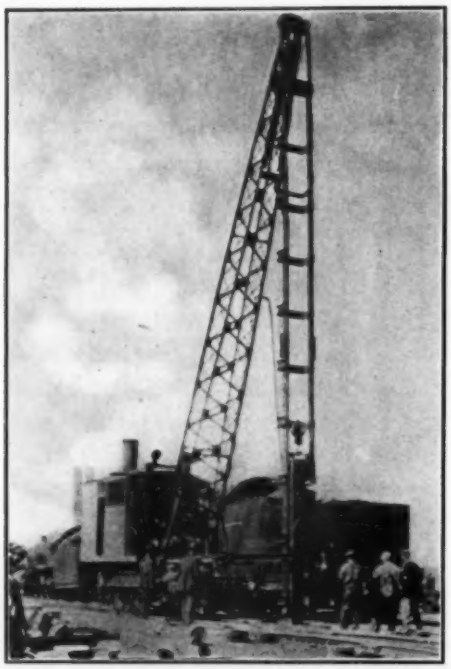
RUGGLES

ROAD BUILDER

Pile-Driving Equipment

Hammers Designed for Steam or Air Operation

WHEN plans are being made for pile driving, it is necessary to know several facts to correctly determine the proper size of hammer to use in order to secure the maximum efficiency. First, the nature of the soil must be known; second, the kind and size of pile; third, the weight of pile; fourth, the area of cross-section of pile; and fifth, the penetration required. As excess weight of the hammer and consequent extra power is not a disadvantage, it is far better to use a hammer a little larger than actually needed than to use one too small. On easy driving, steam pressure and supply can be decreased on a hammer with excess capacity, while with a hammer too light for the work, the wear and tear on handling equipment, hammer and pile, as well as the extra time required to drive the pile, costs more than the small added expense for the operation of the larger machine.



A UNION HAMMER OPERATING ON A GRADE-SEPARATION JOB AT THE CROSSING OF THE PENNSYLVANIA AND WABASH RAILROADS, FORT WAYNE, IND.

The traffic on both roads is unusually heavy at this point and it was necessary to clear the tracks at very frequent intervals throughout the day. Hence, the contractor was forced to use a rig that would drive the piles quickly and would be sure to drive them below grade, as many of them were between the tracks. The piles were up to 19 inches in diameter with the tips averaging 12 inches. Prior to the contract of Herman W. Tapp, of Fort Wayne, Ind., this work was undertaken by another contractor with another rig, who was only able to drive four piles per day, while with the Union equipment, the average was brought up to 17 piles a day, and on one day 27 piles were driven. The soil consisted of limestone screenings, cinders, old ballast and fill

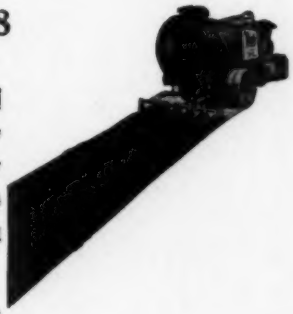
The principle of operation of Union pile hammers made by the Union Iron Works, Inc., Hoboken, N. J., is as follows: On opening the throttle valve, steam or air is admitted to the lower port in the cylinder, raising the ram to the top of its stroke, the valve being actuated by a rod and rocking lever. When the ram is raised, steam is admitted to the upper port, causing the steam under the piston head to exhaust through the lower port. The full pressure of steam acts on the piston for the entire length of the down stroke, thereby increasing the force of the blow over gravity in direct proportion to the effective steam pressure acting on the piston. This makes the pile hammer double-acting. After the throttle valve has been opened, the operation of the hammer is continuous until the supply of steam or air is shut off.

The body or frame of all sizes of Union power hammers is a semi-steel casting in one piece and is not made in sections held by bolts. The upper portion contains the cylinder, while the ram guides are cast into the lower half, thus assuring the correct alignment of the cylinder with the ram guides. Economy of steam or air is obtained by the design of the valve mechanism and the movement of the valve. All hammers are equipped with a patented inlet and lubricator made of one casting forming an oil chamber which is packed with absorbent felt to retain the oil. The oil is pumped into the steam tank through a small hole drilled directly over the inlet to the hammer. The oil cannot run back through the hose, which prevents the deterioration of the tube of the hose. Another important feature is the method of connecting the hose to this part. The hose hangs straight down and does not project several feet in front of the hammer, to be knocked off when landing piles. The construction is so rugged that it cannot be easily injured.

Special bases for different kinds of work are furnished. By using a base for driving round-wood piles the pile is securely held at the top and insures straightness in driving. The head of the pile is held by the walls of the base, which acts much the same as a pile ring and prevents brooming. When a base is used, a light striking plate can be employed, allowing the full force of the blow to be transmitted to the pile, while the heavy "dolly" absorbs part of the power of the blow. When driving steel sheeting, it is necessary to prevent injury to the heads of the piles, so that they can be pulled with a minimum effort. The base not only prevents brooming of the heads, but also provides the close fit between the pile and the hammer.

Revise your specifications—

12 gallons now does the work of 18



"TARVIA-KP" has been greatly improved — its binding strength has been vastly increased. Twelve gallons of the new "Tarvia-KP" are all that are required to each cubic yard of aggregate to make a perfect patching mixture.

This new mixing proportion has been carefully checked many times during the past season. Highway officials enthusiastically recommend it. For it means big savings in cost of materials and gives a better job.

A trial with the twelve-to-one proportion and a comparison of results will convince the most skeptical.

Note: "Tarvia-KP" is the recognized First Aid Kit in highway emergencies—good for every type of pavement. Unvarying in quality and unfailing in service, "Tarvia-KP" demands and holds first place in its field.

The Barrett Company

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Tarvia-KP

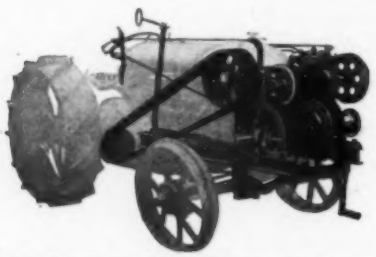
FOR COLD PATCHING

A Portable Hoist for Fordson Operation

New Unit Materially Reduces Hoisting Costs

A POWERFUL, durable, winding drum hoist, either single- or double-drum, reversing or non-reversing, is produced by Pioneer Tractors, Inc., Winona, Minn., in its Porta-Hoist, which is readily bolted to the front of a Fordson tractor and operated by a belt from the Fordson pulley.

The Pioneer Porta-Hoist is assembled in a one-piece rigid main housing casting which carries the transmission gear case and bearing housing for shafting, thus insuring perfect alignment of the working parts, as well as ease of attachment. The main drum is 8 inches in diameter and 14 inches long between flanges, and rotates free on the drum-shaft on bronze bushings. The brake drum is of large capacity and the ratchet teeth for the positive locking dog are cast integral with the drum flange on one end, and clutch friction blocks in four sections bolt to the drum flange on the opposite end.



DOUBLE-DRUM HOIST MOUNTED ON FRONT OF FORDSON

The mean cable speed with standard drive is 140 feet per minute with a lifting capacity of 3,500 pounds on a single line for continuous operation. A lifting capacity of over 4,000 pounds of single line is possible for occasional heavy loads, and by a reduction in speed a still greater load can be raised, as this hoist is designed sufficiently rugged to withstand loads in excess of 5,000 pounds.

The hoist is mounted on two rigid steel channels secured to the Fordson tractor by a special bracket casting attached at the joint between the motor and transmission housing and supported in front by a pedestal casting of rugged design through which the front axle king-bolt passes. This mounting places practically the entire weight of the hoist on the front axle and wheels and eliminates strains on any tractor castings. The clearance under the tractor is not reduced by the Porta-Hoist attachment. Extension of the starting crank is furnished by the manufacturers, permitting cranking of the motor in front of the hoist.

The Porta-Hoist has been used for many types of contracting work, among the most interesting being the operation of double-cage material elevators to eliminate hand labor and speed up building operations, the operation of an excavating bucket on boom, and the operation of a standard type pile hammer with a 1,600-pound hammer.

A Heavy-Duty Dump-Truck to Meet New Needs

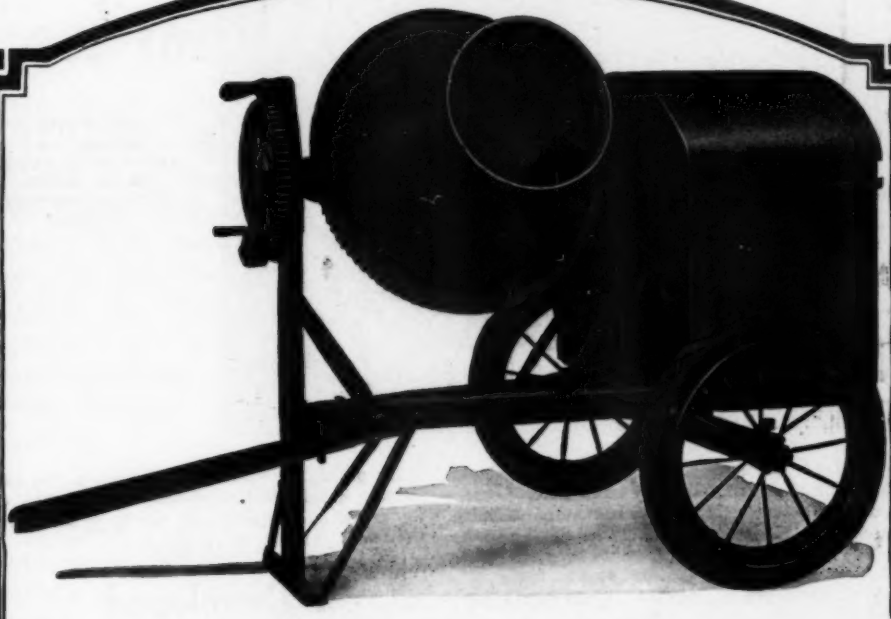
Greater Speed and Safety Developed in Dumping Sticky Loads

A NEW heavy-duty Model 52-D dump-truck, built along the general lines of the White Model 45-D but with many refinements, has been announced by The White Company, Cleveland, Ohio. The purpose of this new model is to meet changing conditions in the industry with a truck that anticipates the highly developed demands of dump-truck transportation. This truck has an auxiliary transmission affording the equivalent of five speeds, giving extra low gear pulling power for hill climbing and getting out of holes or mire, a new dumping mechanism, and tapered dump body, an improved and patented oil system, and the exclusive White double reduction gear drive.

Other new features include a large tubular type radiator, spring cradles on the frame, a wide, heavy, pressed steel bumper, heavier, easy working steering gear, an air temperature regulator that saves fuel and adds to engine efficiency in all speeds, heavy springs, a reinforced frame of chrome nickel steel and brakes with drums of a special metal that insures quick, certain stopping, and long brake-life.

Incorporated in the same case with the auxiliary transmission is the mechanism which operates the dumping hoist. The tapered dump body is raised on arms and links by means of a speedy and positive gear drive, which lifts the body to an angle greater than 50 degrees, dumping the load clean. The body is under positive control at all positions and may be held at any angle. It is lowered by the same mechanism that hoists it, but can be lowered while the truck is in motion on its way back for another load. At normal rest position and at the extreme dumping angle, the body is automatically stopped.

The body is mounted so that the load weight is properly distributed, and the dumping point is so far back that the load slides neatly over the edge of a soft fill without danger of miring the truck, or piles up clear of the truck on flat



Greater Portability—More Yardage!

Speed in getting from job to job is a big item in daily yardage. It gives you those extra batches which go into the "profit column." Moving the Kwik-Mix Trailer—setting it up—is only a matter of minutes. It gets to the job as fast as you do.

Pneumatic or cushion tired wheels on the Kwik-Mix Trailer permit it to ride lightly over city streets, "taking up" the strains and protecting the mixer from sudden jars and jolts.

Besides the portable feature of the Kwik-Mix Trailer—it has capacity, sturdy construction, and dependable power. It has an "over-sized" drum which will give you more liberal yardage than its rated capacity.

In the Kwik-Mix you get a visible mix—quick mixing, quick discharging. It can be charged or discharged from either side.

Investigate this fast operating mixer. Kwik-Mix engineering and modern plant facilities, with increased production, now make it possible to offer you the same high grade Kwik-Mix Mixers at our present lower prices. Let us give you specific details of its construction. Write for catalog which shows the complete line of Kwik-Mix Mixers from the small 2 ft. to the "One-Bag" size.

THE KWIK-MIX CONCRETE MIXER CO.

Port Washington, Wis.

KWIK-MIX
CONCRETE MIXER

NEW WHITE MODEL 52-B HEAVY-DUTY DUMP-TRUCK WITH BODY IN DUMPING POSITION

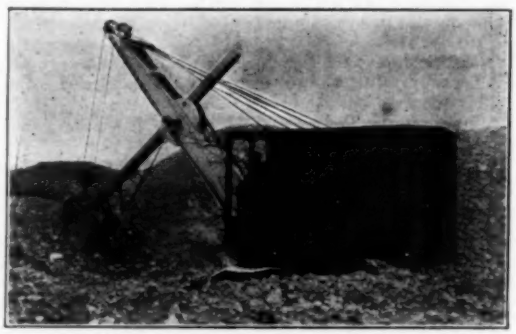
ground. A double-acting tail-gate further facilitates dumping, and low body sides make loading from the ground exceptionally easy. The dumping mechanism is set solidly down in the frame in a dirt-proof and weather-proof housing, the gears running in oil. The wheel-base is 156 inches, and the truck is equipped with 36 by 6 solid front tires and 40 by 12 solid rear tires.

A New Gasoline Shovel Developed

With Size of ¾-Yard Machine New Unit Has Capacity and Range of 1¼-Yard Machine

THERE is always a reason for improvements in dirt-moving machinery, and this is the story of the development of the new Lorain 75 gasoline shovel by the Thew Shovel Company, Lorain, Ohio.

The first power shovels were steam-operated. Improvements were made from time to time, and a highly efficient steam shovel was finally developed. Then came the dawn of the gasoline era, during which existing designs of shovels were modified. With the speed and methods of to-day, larger shovels and cranes are in demand. Motor trucks are rapidly replacing dump-wagons for hauling. When two ¾-yard dippers filled a wagon, the ¾-yard shovel was ideal, but when the larger motor trucks must be kept moving, the demand for increased dipper capacity would not be denied.



THE NEW LORAIN 75 IN ACTION

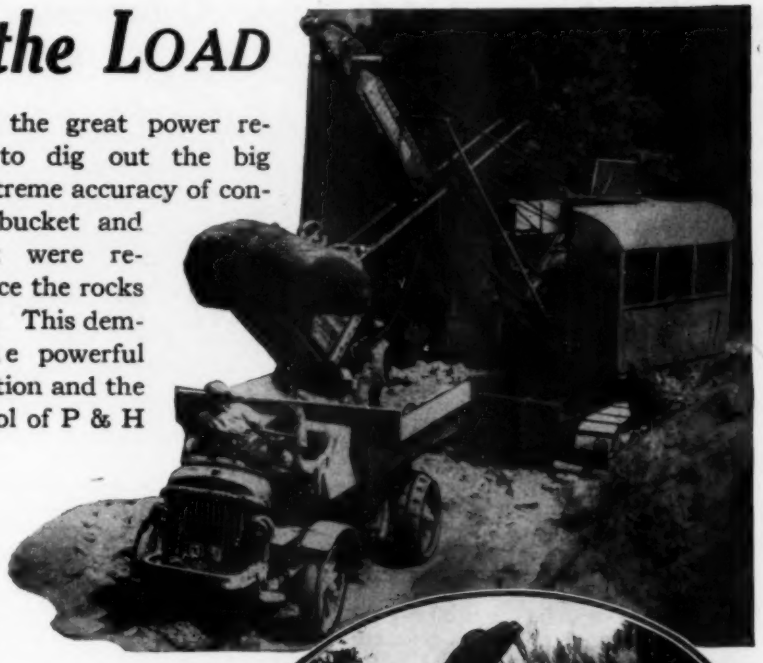
Casting precedent and custom aside, the Thew Shovel Company engineers have developed the Lorain 75, which weighs but little more than a ¾-yard shovel, yet has the power and working capacity of a 1¼-yard machine. It requires no more clearance room for the house, rear end swing, or boom radius than a ¾-yard machine, yet has the digging and dumping range of the larger unit.

The machine is built with a surplus of power and yet the manufacturers state that it possesses strength throughout greater than any strain that the surplus power can develop. It is possible to stall the powerful engine without overstraining any part of the shovel.

In spite of its light construction, the shovel has ample stability for shovel service, with a dipper of 1¼-yard capacity and crane booms up to 50 feet in length. It has a three-lever control and requires no greater physical effort by the operator than a steam machine. The shovel is mounted on the Thew center-drive truck, which has demonstrated its value in the last year since it was exhibited at the 1925 Road Show.

Feel the LOAD

BESIDES the great power required to dig out the big boulders—extreme accuracy of control of the bucket and dipper stick were required to place the rocks in the trucks. This demonstrates the powerful crowding motion and the precise control of P & H Shovels.



This accurate control is made possible by the P & H power clutch, which not only eliminates the back-breaking work of the old manually controlled clutch, but ***permits the operator to feel the load*** at all times. A pull of the little finger closes the lever,—the clutch does not ***lock,***—the operator feels the "bite" and has constant control of the load, saving all unnecessary strains.

The accurate control of the P & H bucket and dipper stick is exemplified by the way in which the big rocks were eased in at the end of the truck, without damage to the latter. This Shovel is excavating on Sonora Long Barn Road, Tuolumne County, Calif.—George Carrico, contractor.

HARNISCHFEGER CORPORATION
Successors to
PAWLING & HARNISCHFEGER CO.
Established in 1884
3819 National Avenue, Milwaukee, Wis.
Warehouses and Service Stations: Philadelphia, Memphis, Jacksonville, San Francisco, Los Angeles, Seattle

P&H SHOVELS
Gasoline – Diesel – Electric

A Flexible and Adaptable Compressor Outfit

Fordson-operated Unit Shows Wide Range of Uses

AN engine-driven portable compressor costs more than a Curtis-Fordson combined unit, made by the Curtis Pneumatic Machinery Company, 1671 Kienlen Ave., St. Louis, Mo., according to the manufacturer, and yet the former machine has an engine which cannot be used as motive power, whereas the latter outfit uses the Fordson as driving power for the compressor and motive power as well. Prior to the development of the Curtis-Fordson, a portable compressor was usually towed to the job and then pushed and pulled about by hand as work progressed, requiring that a number of men be taken from their work for a substantial part of their time. This is now eliminated, as the unit can move itself around.

BREAKING PAVEMENT AHEAD OF SEWER EXCAVATION

Even to the small contractor this combined unit represents no serious problem due to investment or overhead expense. Various applications of Fordson traction and power are so general that the tractor itself will seldom be idle when air is not required. Consequently, half the price of the tractor may well be charged to other than air uses.

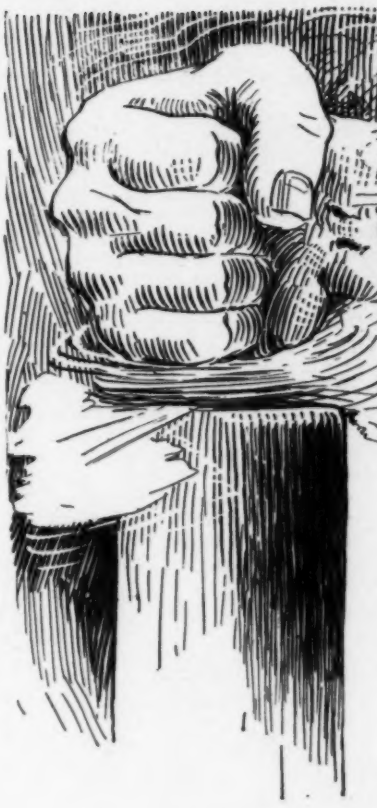
The Curtis portable compressor for the Fordson has 100-cubic-foot displacement. This capacity is right for one drill for 12-foot depths or two drills suitable for 6-foot depths, or two paving breakers, or three backfill tampers, or for many other types of air tools. This capacity is correct, because a smaller size would not handle the ordinary requirements of rock drilling. Analysis shows that it is right for larger than 100-foot total displacement requirements, because two of the units will do everything that the ordinary type engine-driven 200-foot portable could handle, and many things that a 200-foot machine could not handle. A leading St. Louis contractor who first bought a single Curtis unit found it so convenient that he soon added another for his sewer work, one unit breaking pavement ahead of trenching excavations, and the other unit following behind for backfill tamping. A third unit was soon added for work on separate jobs. Obviously, a 300-foot portable could not supply air on three separate contracts at one time, while the three outfits can concentrate on one job or work on three separate jobs if needed.

TAMPING BACKFILL AROUND A SEWER

A striking illustration of the flexibility and wide range of uses of this unit is supplied by the experience of another who also operates a quarry. He first used the compressor for two seasons in turn for rock excavations and for small sewer contracts, breaking paving through city streets preparatory to excavation on larger sewer construction and for tamping backfill around sewers. At present the machine is daily drilling holes 11 feet deep at the quarries, and easily handles 125 to 130 lineal feet of drilling per day on one shift, yielding about 3,000 cubic feet of rock for the crusher at a cost for fuel and lubricating oil of about $3.

Officers of Ruggles Motor Truck Company

THE Ruggles Motor Truck Company, Saginaw, Mich., has announced the election of J. W. Fordny, formerly Chairman of the Ways and Means Committee of the United States Congress, as President; R. J. Goldie, First Vice-President and General Manager; H. R. Wickes, Second Vice-President; Charles T. Kerry, Treasurer; E. L. Smith, Secretary.



Steam STRIKES as gravity pulls

That's the famous McKiernan-Terry "Double-Acting" principle behind every ram in every "McK-T" Hammer! It applies whether you're using a little No. 1 at 500 blows a minute or a big 11-B at 120 blows. It means that every blow has *several times the driving power* that gravity alone could give it. It means you drive faster, better, cheaper—more profitably.

If these things mean anything to you—write for latest Bulletin 35.

McKIERNAN-TERRY DRILL COMPANY

Pile Hammers — Lifting Jacks

19 Park Row, New York **Works, Dover, N. J.**

McKIERNAN-TERRY

The Pioneer Double-Acting Pile Hammers

When writing to advertisers, please mention the Contractors' & Engineers' Monthly—Thank you.

A New Full-powered 21-E Paver

Every Pound of the 40-Horse-Power Gasoline Engine Put to Work

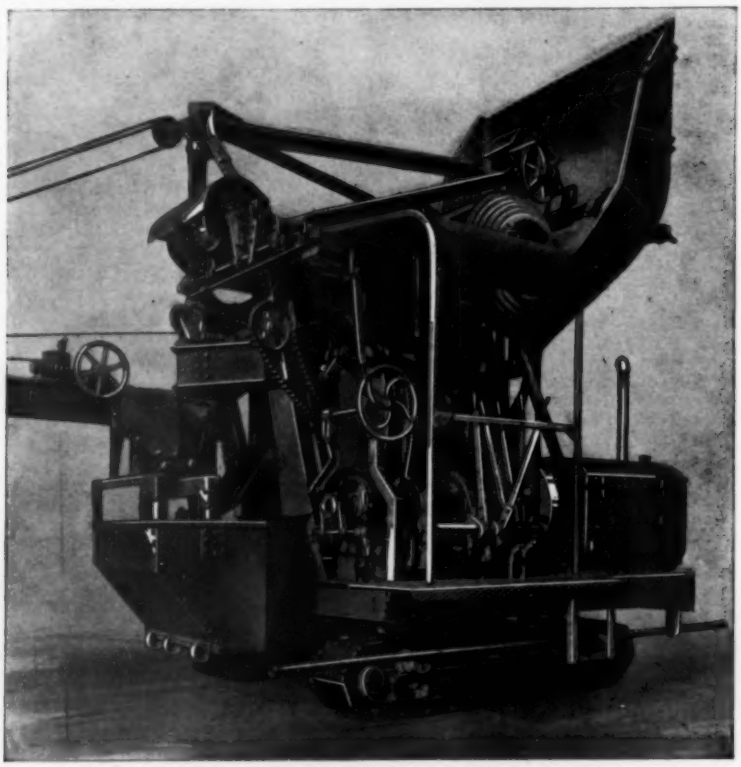
YEARS ago when only steam engines were used on concrete pavers, there wasn't room for anything bigger than 15-horse-power, and transmission gears, shafts, weight, etc, were designed accordingly. The gasoline engine develops 40 horse-power in less space than was required for the 15-horse-power steam plant, and the Ransome Concrete Machinery Co., Dunellen, N. J., in its new 40-40 21-E paver has designed all the transmission parts at least twice as strong as those used when steam was the only power. In the crawler mechanism some parts are said to be four times as strong.

In the extra-heavy crawler construction a crawler shaft 4½ inches in diameter is used for driving the crawler, and the upper traction is also 4½ inches in diameter. The chain connecting these shafts is steel bushed roller chain with case-hardened pins and bushings. The crawler frame is an 8-inch heavy channel construction. The treads are of open-hearth high-carbon steel with full hinge joints, having a 3½-inch wide flat track surface for the tread rollers to travel on.

The mixing drum is built of steel plate which cannot be broken by hammering or by water freezing in it. Since a paving mixer cannot always stand level like a stationary mixer, and from the very nature of its work is often called upon to work upon rather steep grades, this machine has been given a very liberal drum capacity. Using coarse aggregates with 40 per cent voids and one gallon of water per cubic foot of mixed concrete, this paver will hold the following bag batches: 1:2:3 seven bags, 1:2:4 six bags.

The shape and number of blades combined with a deep, wide discharge chute make it possible to quickly and successfully handle very dry mixes. In the drum rollers Hyatt heavy-duty roller bearings are used, because they not only reduce friction but stand the maximum of abuse, particularly when it comes to neglect in oiling.

The accurate measurement of water is becom-



CONTROL SIDE OF THE NEW RANSOME 21-E PAVER

EASTON

DISTRIBUTORS

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*Concrete Machinery & Supply Company, 2014 Santa Fe Ave., Los Angeles, Calif.

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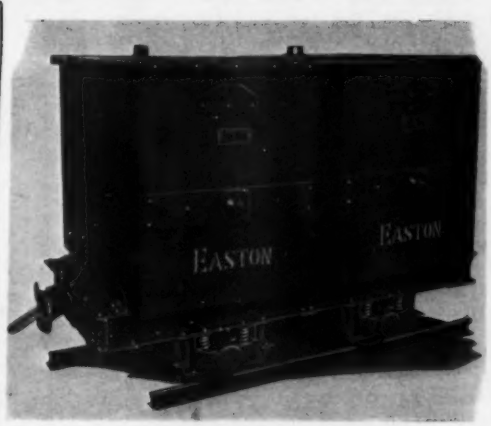


ROAD CAR (with buckets)

The Easton Standard, square frame, two batch box, Road Car is unique in that opposite pedestals are securely tied together across the car with angle iron cross ties.

Batch Boxes can be supplied for any capacity paver—or desired mix. With or without partitions—with cement compartment, with or without cover—or with cement compartment waterproofed.

Write for detailed information and Easton Catalog.

EASTON CARS
FOR EVERY INDUSTRIAL PURPOSE

EASTON CAR & CONSTRUCTION CO.

Offices and Works

KANSAS CITY, MO. EASTON, PA.

ing more and more necessary as the severity of the specifications for concrete is increased. In the Ransome pressure tank, the amount of water required for each batch is controlled by a lever at the side of the tank. This lever raises or lowers the inlet end of the revolving pipe inside the tank, and the water is drawn up only as far as the end of this inside pipe. The outlet and inlet are controlled by a balanced piston valve, which the manufacturer believes the best way to quickly and positively control the water. A sight-feed gage glass is also provided. A 2-inch inlet pipe is provided from either side of the machine, and a 3-inch outlet pipe to the mixer drum.

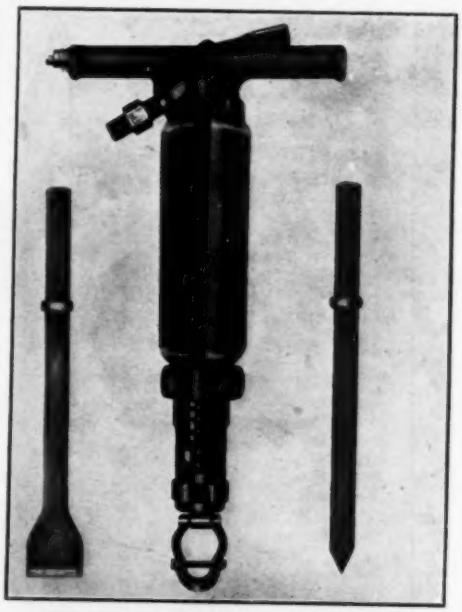
A Practical Demolition Tool for Concrete

Unit Fits in Admirably Where Drilling and Blasting Are Impractical

A CONCRETE breaker has been designed by the Denver Rock Drill Manufacturing Company, Denver, Colo., to meet the needs of municipalities, contractors, public utilities, and various industries where a compressed-air-operated demolition tool is desirable, and for use on jobs where drilling and blasting are impractical. This Model-15 Waugh concrete breaker can be used with substantial saving in labor and time for cutting and breaking up asphalt, for breaking the concrete subbase in street repairs, for breaking and excavating masses of concrete, for demolishing walls of brick, masonry or concrete, for tearing up brick, wood, or stone block pavements, for fracturing boulders, for loosening tightly packed or frozen soil or macadam, and for trenching in shale or hard-pan.

In construction, this breaker is rugged and simple, and it has great penetrative and fracturing power. The materials throughout are of the highest quality obtainable and scientific heat treatment insures maximum service. The valve and the hammer are the only moving parts, and a simple poppet valve actuated by a trigger conveniently placed in the handle controls the operation of the machine. It is claimed that an unskilled man without instructions can operate this unit instantly and effectively.

The length of the machine is 23½ inches. When the chisel bit, gad or other special tool is in service, the over-all length is most convenient for a man of average height. The handles are of ample diameter and width. The machine is smooth in operation, a feature which minimizes fatigue and insures satisfactory daily output with any class of labor.



THE NEW WAUGH CONCRETE BREAKER

Since tools of this type are frequently used in places far from service men, the manufacturers have spent more time than is customary in developing this tool as a rugged, fool-proof unit.

New McKiernan-Terry Distributors

THE McKiernan-Terry Drill Company, 19 Park Row, New York, has announced a number of important additions to its distributors. Exclusive contracts have been made recently for McKiernan-Terry representation by the Funkhouser Equipment Company, Kansas City, Mo.; the Geo. F. Smith Company, St. Louis, Mo.; Ole K. Olsen, New Orleans, La.; Edward R. Bacon Company, San Francisco, Calif.; Garlinghouse Brothers, Los Angeles, Calif.; Yancey Brothers, Atlanta, Ga.; Julien P. Benjamin, Jacksonville, Fla.; and D. C. Elphinstone, Inc., Baltimore, Md.

Bay City to Have Warehouse at Roselle, N. J.

THE Bay City Dredge Works, Bay City, Mich., has purchased property at Roselle, N. J., and is now building a steel warehouse and service station. A siding is to be constructed to the B. & O. railroad, whose tracks pass the property. This warehouse will be used for the storage of new Bay City excavators, Model 16-B and Model 4, and a complete line of parts for immediate delivery. The warehouse will be under the direction of the eastern office of the Bay City Dredge Works, which is at 302 Broadway, New York; Eugene P. Reading, Manager in charge.

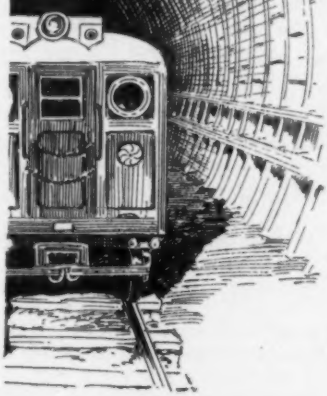
110,000 Yards in 26 Days

THE new subway under North Broad Street, Philadelphia, Pa., being built at a cost of about $100,000,000, is to have a four track system and will be in operation about January 1927.

During the excavation for this subway 15 Mundy hoists lifted 110,000 cubic yards in 26 days. Now 21 Mundy hoists are at work speedily removing the excavated material from shafts sunk 35 feet below the street. Mundy 40 H.P. Double Drum electric hoists with swinging drums, connected to stiff leg derricks using 36 cubic ft. buckets are doing this work. Each hoist is raisng an average of 280 cubic yards daily from the bottom of the shaft to the dumping hopper.

In railroad, bridge and subway construction Mundy hoists have played an important part during the past 55 years. An attractive 40 page booklet, just off the press, describing Mundy Gasoline hoists is now ready, you can get your copy by dropping a card.

TRADE MARK
MUNDY
ESTABLISHED 1869



The Mundy Sales Corporation

Distributors for the J. S. Mundy Hoisting Engine Co.

30 Church St., New York

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MUNDY HOISTS

THE HOIST WITH THE ASBESTALL FRICTIONS

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SPECIAL 4-A BUCKEYE TRACTION DITCHER DEVELOPED FOR CORAL ROCK EXCAVATION IN FLORIDA

Sewer Construction in Coral Gables

Giant Ditcher Replaces Hand Labor on Famous Florida Development

STORM sewers that are being laid at a depth of 6 to 18 feet through the principal sections of Coral Gables, Fla., are of such capacity that heavy storms are able to run off quickly.

The big trencher built by the Buckeye Traction Ditcher Company, Findlay, Ohio, which has speedily handled the job in Coral Gables, has a capacity of 100 hand laborers. According to J. I. Ellington, Superintendent for the J. E. McCrary Engineering Corporation of Atlanta, Ga., which has the entire contract for the sewer, the use of their four machines of this type has eliminated the need for tons of dynamite which would have been necessary to loosen the coral rock had hand labor been used.

Over 4½ miles of storm sewer have already been placed in Coral Gables, ranging in size from 12 to 36 inches. For a distance of 4,000 feet on Granada Boulevard, this sewer has been placed at from 6 to 12 feet under water where the excavation reaches its maximum depth. The trenching machine must dig to a depth of 12 feet on a portion of this stretch of the work.

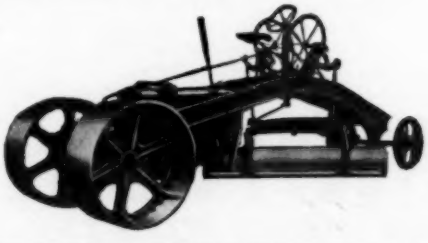
The placing of sewers even of unusual size is no longer considered a great engineering feat under ordinary conditions, but in the American tropics where water is encountered at a depth of a few feet, it is truly a big task. The services of several high-pressure pumps have been required to keep the excavations from filling with water.

Although on most large projects special machines follow the ditcher for backfilling, the machine illustrated, after digging a trench 12 feet deep, has been handling that work itself. The daily capacity of the machine under Florida conditions is about 400 feet.

Interchangeable Wheels for Motor Grader

Standard Grader Rubber-tired or Road-Roller Wheels May Be Used Effectively

RAPIDLY increasing attention to the proper maintenance of earth and gravel roads and a very rapid increase in snow removal in the northern states have created a need for more effective machinery for both kinds of work. The Galion Fordson-powered one-man motor grader has been developed by the Galion Iron Works & Manufacturing Company, Galion, Ohio, for this particular kind of work. The newest Galion one-man grader is known as the Galion "Standard." In this machine sturdy strength is secured by an 8-inch frame and extra reinforcement throughout. A 16-foot wheel-base adds to its effectiveness in



GALION-FORDSON ONE-MAN GRADER WITH ROAD ROLLER WHEELS IN REAR

Add Five More Horsepower To Your Fordson

More Power More Profit From Your Fordson

Spend an hour's time installing a Waukesha "Ricardo" Replacement Head on your Fordson and instantly you have 3 to 5 more horsepower. You can do work in high that formerly required low gear. The reduced fuel consumption often saves a dollar a day, soon paying for the head. With this head, Fordson performance is on a par with internationally known Waukesha "Ricardo Head" Motors, now used in thirty-two different kinds of industries.

Waukesha "Ricardo Heads" are moderate in price. Contractors are equipping entire Fordson fleets with them. If your dealer or jobber can't supply you, write us. Booklet "000" on request.

WAUKESHA MOTOR COMPANY

Waukesha Wisconsin

Builders of Heavy Duty Industrial Motors for Twenty Years

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smoothing roads, and 30-inch lift wheels give the operator extra leverage in lifting the blade with the machine-cut worm gear.

The operator is comfortably and safely seated where he can view all the work and the road ahead at a single glance. Both the seat and the steering wheel are easily adjustable to suit various operators.

This one-man motor grader can be equipped with the regular Fordson wheels or with dual rubber-tired wheels in the rear using any standard make. For heavier work any standard crawlers for the Fordson may be used. A new idea which will appeal to many road maintenance men is the use of Galion roller wheels in the rear. This will permit the grading and rolling of an earth road in one operation. By adjusting the blade, the spoil can be thrown into the wheel ruts, and the roller wheel following will roll it down, packing the earth firmly, and leaving a solid, smooth surface.

The Galion line includes Fordson-powered rollers of three distinct types, ranging in weight from 3 to 10 tons, and a belt-conveyor to be used with a Fordson tractor or with a Ford engine.

A One-Piece Road Material Outfit

Portable Unit a Boon to Road Contractors

A PIECE of portable machinery which in one operation conveys material from a gravel-pit or quarry ledge, crushes, screens and delivers the finished product direct to the storage or loading bins from which material is always readily available, is manufactured by the Iowa Manufacturing Company, Cedar Rapids, Iowa. The entire outfit is driven from the crusher flywheel, making an easy-running, effective plant allowing the use of the valuable oversize rock at a cost slightly greater than the unsatisfactory screened pit run. The plant is simple in design, is practical, complete, and portable, with large capacity and low power requirements, minimizing the haul for material and capable of producing material from ¾-inch up.

THE CEDAR RAPIDS ONE-PIECE OUTFIT SET-UP, SHOWING METHOD OF DELIVERY TO STEEL BIN

In the Cedar Rapids one-piece outfit all material is discharged by the feed conveyor into a double self-cleaning and non-clogging revolving trunnion-type screen. The inner screen acts as a grizzly for the outer or sizing screen. Material to size is delivered directly to the discharge conveyor which empties into a storage bin. The remainder, or oversize material, is rejected by the screen to the crusher, where it is reduced and elevated back through the screen, allowing any material of maximum size and under to reach the discharge conveyor and bin.

The crusher is the Cedar Rapids force feed type jaw crusher, which permits of positive and economical production of small crushed rock which is thoroughly mixed with the fine by the action of the revolving screens. This mixing gives a uniform material and prevents the spotted condition so often found when the ordinary material is spread on the ground. By a slight change in the standard outfit it will produce material to conform to specifications which are now being more widely adopted; that is, for example, maximum size 1-inch and all material not passing a ¼-inch screen must be crushed. This is accomplished by placing the smaller perforation on the inside screen instead of the outside as usual and returning the material from the crusher to the space between the screens instead of the chute from the feed conveyor as is done on the standard outfit.

In the production of road-surfacing material an excessive amount of fine has always been a source of great expense and difficulty. An attachment has been developed for the Cedar Rapids one-piece outfit which accomplishes this elimination without added expense or trouble. Sliding doors cover sand perforations in the forward cone of the screen and can be opened to permit the passage of the excess fine onto a short conveyor which delivers it to a truck or waste pile without interfering in the least with the rest of the operation. This attachment makes it possible to produce specification material, without resorting to the old and expensive method of screen separation and the resultant remixing of various sizes, which is always unsatisfactory.

CURB AND GUTTER

CURB

INTEGRAL CURB AND BASE

BATTERED CURB

SIDEWALK

ROAD FORMS

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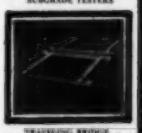

TRAVELING BRIDGE

CAR UNLOADERS

MORTAR BOARD

TOOL BOXES

JOINT MACHINES

BATCH BOXES

BATCHER

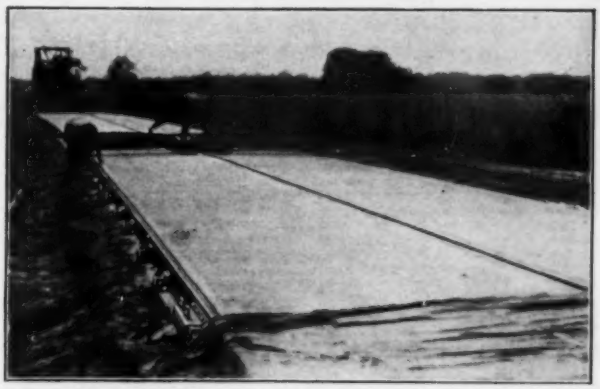
TRAILER BATCHER BIN

STATIONARY BINS

MANHOLE FORMS

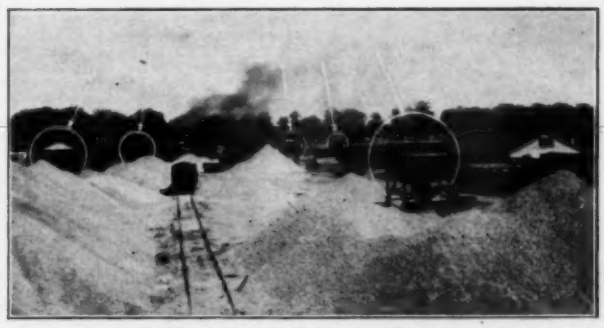
PIPE FORMS

SEWER FORMS



More Than 75,000 Feet of HELTZEL Forms are being used by The Union Paving Co., Philadelphia.

Write for new Road and Form Catalog.



A typical installation of Heltzel bins and batchers in a material yard, just finishing their fourth year of service.

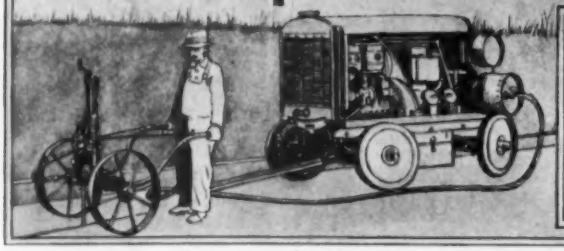
Write for Batcher Bin Catalog.

The Heltzel Steel Form & Iron Co.

Warren, Ohio

HELTZEL

Helpful Material



The catalogs and pamphlets listed below are available for free distribution. Contractors and Engineers who check over these pages each month and write for such material as interests them, will find this a valuable means of keeping up to date on the subject of machinery and equipment.

AN EFFECTIVE CONCRETE ROAD FINISHER

The Ord concrete road finisher, which gives a stronger concrete road in that it removes air and water pockets in the concrete and turns the coarse aggregate so that it presents flat sides to the wear of the traffic, is described in the latest literature of A. W. French & Co., 8440 Lowe Ave., Chicago, Ill.

AIR-COMPRESSORS OF PROVED ABILITY

The Buhl Co., manufacturers of portable air-compressors for contractors desiring to cut their costs, speed up the job, and have greater net profits, has issued a folder describing its various units, which may be secured by writing to the Buhl Co., 405 S. Dearborn St., Chicago, Ill.

A WELL-BUILT SIMPLE DRILLING MACHINE

The Amazon drilling machine, which is capable of handling blast-hole work and which has no noisy gears but is run through all-friction control, capable of handling holes up to 300 feet, is described in an illustrated folder which may be secured from the Burch Plow Works Co., Dept. MA, Crestline, Ohio.

AIR SPEEDS UP JOBS

In Booklet 131 issued by the Sullivan Machinery Co., 162 S. Michigan Ave., Chicago, Ill., contractors will find a wealth of hints and information on the diversified uses of compressed-air equipment.

A RELIABLE BELT CONVEYOR

The Chicago automatic conveyor of the belt type, which is built in sizes from 12 to 50 feet in length and with troughed rollers and steel drags, is described completely in a circular which may be secured from the Chicago Automatic Conveyor Co., Old Colony Bldg., Chicago, Ill.

IMPROVEMENTS IN MAST PLANT FOR CONCRETING

Bulletin 115-A which may be secured from A. P. Robinson, Sales Mgr., Ransome Concrete Machinery Co., Dunellen, N. J., contains a wealth of information regarding the latest improvements to the well-known, efficient, and economical Ransome Monkey-on-a-Stick concrete-chuting plant.

A POWER WINCH BACKFILLER

The Miami backfiller extension, devised for use with the Miami power winch, which, it is claimed, has demonstrated that it can save 50 per cent on all shallow trench backfilling jobs, is described in detail in the latest circular of the Miami Trailer-Scraper Co., Troy, Ohio.

POWERFUL CLAM-SHELL BUCKETS

The latest illustrated catalog of Joseph F. Kiesler Co., 936 W. Huron St., Chicago, Ill., describes the various types of Kiesler clam-shell buckets and shows them in service.

A NEW STEEL FORM THAT EQUALS TWELVE

The new "E-Z" Hotchkiss form for the construction of concrete walks, curbs, gutters, drives, etc., which is built in all sizes for each type of work, is described and illustrated in a bulletin issued by the Hotchkiss Steel Products Co., Inc., Binghamton, N. Y.

HIGHER EFFICIENCY THROUGH ONE-MAN GRADERS

The Hadfield-Penfield Steel Co., Bucyrus, Ohio, will be pleased to furnish any interested contractors or highway officials with its illustrated literature describing the H-P Highway Patrol and Road Builder, which is a one-man grader of widely diversified uses and great ability.

AN ELECTRICALLY WELDED STEEL DUMP BODY

The No. 8 Eagle Universal steel dump body made of high-grade 10-gage sheet steel electrically welded, with the bottom and sides smooth and free from any bolts, rivets, or welded seams, is described, with the dumping mechanism, in the latest folder of the Eagle Wagon Works, Auburn, N. Y.

AN EFFICIENT TILTING DRUM TRAILER MIXER

A handy and efficient 4-cubic-foot mixer with tilting drum, which is mounted on a rubber-tired trailer, and which will satisfactorily handle a large percentage of jobs on which larger mixers are now being used, is described in the latest catalog of the J. B. Foote Foundry Co., 32 Front St., Fredericktown, Ohio.

A CONVERTIBLE EXCAVATOR

The Model 16-B convertible ¾-yard Bay City excavator, which handles skimmer bucket, clam-shell, or ditcher, is described in an illustrated catalog published by the Bay City Dredge Works, Bay City, Mich.

CRANE, SHOVEL, OR DRAGLINE

No matter whether your needs for 1926 jobs are a crane, a shovel, a dragline, a ditcher, a skimmer of ½-, ¾- or 1-yard capacity, gas-, steam-, or electric-driven, Orton Crane & Shovel Co., 608 S. Dearborn St., Chicago, Ill., can help you. Send for a copy of the O & S general catalog to help you decide.

CUTTING AND WELDING TORCHES

The Alexander Milburn Co., Baltimore, Md., has published a new catalog covering its complete line of cutting and welding torches. A copy of this catalog will be sent you by this company immediately on request.

A COMBINED ROOTER AND FURROW PLOW

The Wiard "2 in 1" plow, which contractors find is well adapted for both rooter and furrow service, is described in literature issued by the Wiard Plow Co., Batavia, N. Y.

DOUBLE-ACTING FORCE TRENCH PUMPS AND DIAPHRAGM PUMPS

Descriptive bulletins which will be furnished without obligation by the Domestic Engine & Pump Co., Shippensburg, Pa., describe Domestic pumps with dependable power units in both the double-acting force trench type and the diaphragm type.

POWER SHOVELS THAT DIG HARDER MATERIALS

Erie Gas + Air shovels and cranes, which dig harder materials because the full power of the independent hoisting, crowding, and swinging engines can be used at the same time when needed, and which has direct-connected air engines that work only when the shovel is swinging or crowding, are described in Bulletin N-80, "The Shovel that Gets the Work Done," which may be secured from the Erie Steam Shovel Co., Erie, Pa.

A BLASTERS' HANDBOOK

A 198-page illustrated handbook describing and illustrating all kinds of blasting has been prepared by the engineers of E. I. Du Pont de Nemours & Co., Inc., Wilmington, Del., describing practical methods of using explosives for various purposes. A copy of this book may be secured without cost by those using blasting in their contracting operations.

A NEW DRIVE FOR MOTOR TRUCKS

The new relay drive used in Commerce motor trucks, which is said to greatly increase the life of the truck and give 114 per cent more power, is described in literature which may be secured from C. L. Granger, Commerce Motor Truck Co., Ypsilanti, Mich.

A NEW 2-CYLINDER, 3-6-HORSE-POWER GAS ENGINE

Technical Data Sheet No. 130 recently issued by the Novo Engine Co., Lansing, Mich., describes completely the new Novo UF 2-cylinder 3- to 6-horse-power engine for industrial work.

Hotchkiss Steel Road Forms
Hotchkiss Building Forms

Sales Representatives of Hotchkiss Steel Products Company, Inc.

Lee T. Ward Company	Philadelphia, Pa.
Wheeler-Murray Co.	Buffalo, N. Y.
Ward Equipment Co.	Pittsburgh, Pa.
Ginsberg-Penn Co.	New York, N. Y.
H. S. B. Settle	Elizabeth, N. Y.
John C. Louis	Baltimore, Md.
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McDonald & Burgman	Daytona, Fla.
Fickeissen-Finney Equipment Co.	St. Louis, Mo.
Concrete Machinery & Supply Co.	Los Angeles, Calif.
Minneapolis Equipment Co.	Minneapolis, Minn.
Standard Salt & Cement Co	Duluth, Minn.
Huebner Sales Company	Saginaw, Mich.
Bacon Engineering Sales Co.	Cleveland, O.
National Supply Co.	Toledo, O.
McLaughlin Mill & Supply Co., Inc.	Hammond, Ind.
S. H. Edlin Co	Indianapolis, Ind.
Wagner Sales Co.	Knoxville, Tenn.
B. B. Wilson Company	Lexington, Ky.
Southern States Equipment Co.	New Orleans, La.
American Hardware & Equip. Co.	Charlotte, N. C.
C. W. Blakeslee & Sons	New Haven, Conn.
Allen R. Boudinot	Davenport, Ia.
Graham B. Bright Co.	Richmond, Va.
R. H. Hyland Co.	Chicago, Ill.
Contractors Equipment Co.	Miami, Fla.

Hotchkiss Steel Products Company, Inc.

Binghamton, N. Y.

ENGINES FOR HEAVY-DUTY SERVICE

Hercules engines and power units are being used extensively on excavating machinery because they are able to stand up under this heavy, exacting service. You can secure information as to how to outfit your units with Hercules engines, or any other data desired, from Charles Balough, Hercules Motors Corp., Canton, Ohio.

ADDED POWER FOR FORD TRUCKS

The Fuller auxiliary transmission for Ford trucks, which is a sturdy unit rigidly fastened at the rear end of the drive-shaft, giving the trucks four speeds forward and two reverse, is described in the literature of the Fuller & Sons Mfg. Co., Kalamazoo, Mich.

A NEW TRANSMISSION FOR FORDS

Full details regarding Himico transmissions as well as power-plants for Ford trucks, both of which are said to build up the effectiveness of the unit, may be secured from Hinkley Motors, Inc., P. O. Box E-839, Detroit, Mich.

A BOOKLET ON ECONOMICAL MIXERS

The Standard mixer booklet describes this unit, which saves labor and time, gives an increased daily yardage of concrete and assures a good, lasting job. Your booklet may be secured from the Standard Scale and Supply Corp., Pittsburgh, Pa.

STRENGTH, SERVICE, AND SAFETY IN TACKLE-BLOCKS

Anvil brand blocks for manila or wire rope, which have strength, give service, and are always safe, are described in the literature and specifications of the Western Block Co., Lockport, N. Y.

A PORTABLE COMPRESSOR WITH CLUTCH

Catalog C-25-A of Schramm, Inc., West Chester, Pa., describes the new 120 compressor, a portable unit which has a clutch between the engine and the compressor to assure easy starting.

A POWERFUL TRUCK WITH ENDURANCE

"Big Brute" is the name of the 2-, 3½- and 5-ton trucks built by the Yellow Truck and Coach Mfg. Co., a subsidiary of the General Motors Truck Co., Pontiac, Mich., with the power of a giant and the operating ease of a passenger vehicle. These trucks are described in literature which may be secured direct from GMC.

BACKFILLING ON A PRODUCTION BASIS

Information regarding the use of the Fordson tractor, which is now well known as an ally of contractors for a backfilling unit and many other services, may be secured direct from the Ford Motor Co., Detroit, Mich.

HOISTS FOR DRAG SCRAPER WORK

An efficient, low-priced hoist for medium-size pit work, which gives a big output for its size at an extremely low cost per yard, is described in the literature of the Lidgerwood Mfg. Co., 96 Liberty St., New York.

TRUCKS HELP PAVE MORE MILES PER DAY

Ruggles Road Builder trucks, which have enabled road contractors in many states to lay more miles of pavement per day at a greatly reduced cost of hauling the necessary materials, and which are made in a complete range of sizes and types for every dump body need in 1 1/3-, 1 2/3-, 2-, and 2½-yard capacities, are described in the informative literature of the Ruggles Motor Truck Co., Saginaw, Mich.

INTERLOCKING CONCRETE CRIBBING

R. C. cribbing, which is automatic, interlocking and flexible, made of concrete to form an economical, easily constructed retaining wall, is described in a new 16-page illustrated catalog which may be secured from the R. C. Products Co., Inc., Cleveland, Ohio.

A TRACTOR SCRAPER WITH DEPTH CONTROL

The Euclid Crane and Hoist Co., Euclid, Ohio, will be pleased to send prices and discounts on Euclid tractor equipment, including its tractor scraper, which has an automatic depth control that particularly adapts it to use with the small tractor.

A HIGH-POWERED CLAM-SHELL BUCKET

The high-powered Dreadnaught clam-shell bucket, which is sold at a fair price, instead of being an inferior bucket at any price, is described and illustrated in literature which may be secured from the Blaw-Knox Co., 601 Farmers Bank Bldg., Pittsburgh, Pa.

CHASING OLD MAN OVERHEAD OFF THE JOB

The 1926 edition of "Contracting with Barber-Greenes," which may be secured from the Barber-Greene Co., 485 W. Park Ave., Aurora, Ill., shows how many contractors are chasing that terrible bogeyman called Overhead off the job and are using Barber-Greene conveyors and feed-disc loaders to handle material on their jobs.

SUCCESSFUL GRAVEL PLANTS

The Smith Engineering Works, 1820 Holton St., Milwaukee, Wis., will be pleased to send a copy of its Bulletin G. T. 21 describing Telsmith gravel-washing machinery, which has been successful in continuous service on so many jobs.

BOTTOM-DUMPING AND TURN-OVER BUCKETS

Information on turn-over and bottom-dumping buckets of all sizes, steel skips, flat-end and bottom-dump discharge cars, push-carts, asphalt heaters, and lead-melting furnaces, as well as sheet steel pipes, smoke-stacks and concrete chutes, may be secured from the G. L. Stuebner Iron Works, Inc., 45th Ave. and Vernon Blvd., Long Island City, N. Y.

A PILE DRIVER THAT KEEPS PILES MOVING

The double-acting principle of all McKiernan-Terry hammers keeps the pile moving, thus overcoming inertia, friction, and point resistance. Bulletin 35 tells the whole story and gives details which will interest you. A copy may be secured from the McKiernan-Terry Drill Co., 19 Park Row, New York.

HAND BUSH HAMMERS

A size of hand bush hammer for every bushing and dressing job on concrete is made by the Dallett Co., Philadelphia, Pa., and described in its illustrated literature.

A CAREFULLY DESIGNED AND WELL-BUILT SCRAPER

The Perry automatic scraper, which is made in two sizes and with interchangeable parts, is described in detail in the illustrated circulars issued by the Perry Co., Sidney, Ohio.

REAL VALUE IN MIXERS

Four particular features of design in Jaeger mixers, namely, the tilting drum with the flat spots inside, the automatic tip-over water-tank, the gravity discharge, and the power loader, as well as other points which go to make value in a concrete mixer, are described in a catalog which may be secured from the Jaeger Machine Co., 701 Dublin Ave., Columbus, Ohio.

BODIES THAT DUMP SPEEDILY

A dump body which dumps quickly at the mixer skip, thus making it possible to get out increased yardage of concrete every day, is described in the new Anthony catalog, which shows prices and specifications. This catalog may be secured direct from the Anthony Co., Inc., Streator, Ill.

WATER-PROOF GRAPHITE GREASE

Graphite is a vital element in grease for moving-parts, as it imparts to bearing surfaces a remarkable smoothness which relieves the grease of a very considerable portion of its task. Circular 148-W issued by the Joseph Dixon Crucible Co., Jersey City, N. J., describes Dixon's water-proof graphite grease, which is of a dense consistency suitable for general heavy service with slow speeds and heavy pressures.

A NEW LUBRICANT FOR HEAVY-DUTY MACHINERY

D. A. Lubricant, which is a densified Pennsylvania oil for displacing old-fashioned and inefficient cup greases and gear compounds and which is especially adapted for use on heavy machinery, is described in literature which may be secured from the D. A. Lubricant Co., Inc., Indianapolis, Ind.

A NEW PRECISE TRANSIT

W. & L. E. Gurley, Troy, N. Y., have just issued a new bulletin, E-23, describing the Gurley Hell Gate precise transit and its remarkable work.

CAST IRON PIPE FOR INTRICATE INSTALLATIONS

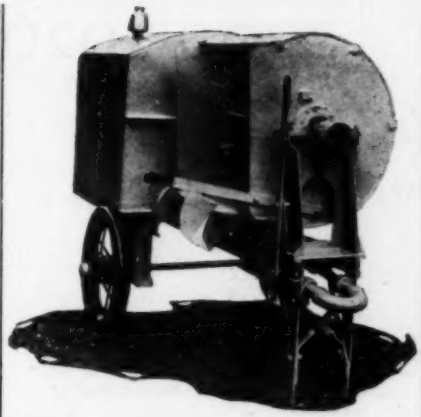
Cast iron pipe lends itself readily even to the most intricate work, and by the very nature of its resistance to corrosion and rust it requires the minimum of maintenance. A copy of the United States Cast Iron Pipe Handbook containing a wealth of valuable information for contractors and engineers may be secured without cost from the United States Cast Iron Pipe & Foundry Co., Burlington, N. J.

A UTILITY BACKFILLER

The Utility backfiller made by the Buckeye Traction Ditcher Co., Findlay, Ohio, and equipped with a full circle swing and a 33-foot boom is described in a catalog which gives detailed descriptions and which will be sent to you free for the asking.

EXPLOSIVES FOR CONTRACTING

A pamphlet, "Effect of Cartridge Diameter on Efficiency of Explosives," as well as other information on the use of explosives in contracting operations may be secured without cost by any interested contractor, from the Hercules Powder Co., Inc., 958 King St., Wilmington, Del.



The result's the thing

BUY results when you buy mixing machinery. And buy them in exact proportion to the cost price of the equipment.

A formidable line-up of results are so many dollars to you and your right to demand them in a mixer gives Blystone Mixerettes the lead.

The most thoro mix of old fashioned hair or hard wall plaster, scratch, brown or finish—result number one.

Sanding plaster from ten to twelve shovels heavier than when mixing by hand, saves you material—result number two.

Elimination of droppings because every batch is uniform and consistent, saves an appreciable amount of material—result number three.

And there are just three of the results.

Would you like to know more about the mixerette which produces real dollar for dollar results? Please write us.

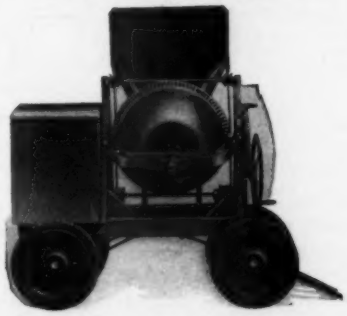
The Sign of Thoroness

BLYSTONE MFG. COMPANY
326-C. Street Cambridge Springs, Pa.

BLYSTONE

THE KIEL

MASTER MIXER



Gives More For The Money

It's only natural that the Kiel Master mixer should do more work than any other mixer because it is better built.

Counter Drive Shaft Bearings—Dust proof. Timken Roller Bearings running in oil. Length of bearing 6 inches.

Drum Spindle Bearing 10 inches long. Ball thrust bearing and phosphor bronze bearings—dust and water proof.

Positive Gear Drive Inclosed in engine cab. No chains to stretch or replace. Drive shaft carried on Timken Roller Bearings.

Balanced Drum and Yoke Large Hand wheel makes easy tilting.

Special Mixing Blades insures fast mixing and quick, clean discharge.

Timken Roller Bearing Wheels with dust proof hub caps and Cushion Tires insures greatest portability.

Plenty of Power—2½ H.P. Engine with Wico high tension ignition.

Large Capacity—over actual rating. Drum size 31 x 28 in. with 18-in. opening. Holds 5½ Cu. Ft. of loose aggregate without slopping.

Compare the above construction, then write us for prices.

KIEL MIXER COMPANY
MILWAUKEE, WIS.

1900-1926

Mack *for profitable Transport service*

For twenty-six years Mack interests have been centered upon the manufacture of Motor Freight Carrying Vehicles and Motor Buses.

Throughout the United States, Canada and in all foreign countries where representation has been established, experienced truck and bus buyers look upon MACK as an investment that not only has a twenty-six year background, but one produced by an organization whose manufacturing and selling policy has been consistent and whose plant expansion and earnings have kept a conservative balance. In short:—To those with experience a sound investment and a MACK are one.

MACK TRUCKS, INC.
INTERNATIONAL MOTOR COMPANY
25 Broadway, New York City

One hundred direct MACK factory branches operate under the titles of: "MACK-INTERNATIONAL MOTOR TRUCK CORPORATION," "MACK MOTOR TRUCK COMPANY," and "MACK TRUCKS OF CANADA, LTD."

MACK TRUCKS · MACK BUSES · MACK FIRE APPARATUS · MACK RAIL CARS

P E R F O R M A N C E C O U N T S

60 WELL-POINTS

LAWRENCE MASSA, pipe line contractor of Huntington Park, California, has three Novo Diaphragm Pumps. Two of them are shown in the picture at right.

One Novo is connected to a string of 60 well-points. As trench excavation went forward, a section of the 4-inch main was disconnected at one end, brought forward and again connected. The Novo Pump was not stopped and operations continued without interruption.

Mr. Massa has recently purchased the third Novo pump, a double open top unit. He says, "It proved to be the best of any I have used. It is a steady pumper, always ready for work. I am well satisfied with it." Novo Diaphragm Pumps, single and double, open and closed tops, have many advantages not found in other makes of pumps. Some of these are listed below.

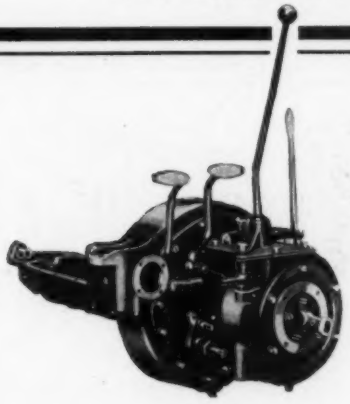
Powered with Novo 1½, 2, 3, 4 H. P. single cylinder and 3-6 H. P. two cylinder gasoline engines. Independent reducing gear on two cylinder engine unit. Oil tight and dirt proof. Oil automatically fed to the bearings. Cleanout and drain in pump base. Machine cut gears in bath of oil.

Double threaded discharge flange. Specially made diaphragm outlasts several ordinary diaphragms.

Other features all illustrated and described in Data Sheets Nos. 99 and 105. Write for complete details.

Novo Double Open Top Pump with 2 cyl. Novo UF Engine.

NOVO ENGINE CO.
Clarence E. Bement, Vice-Pres. & Gen. Mgr.
LANSING — MICHIGAN



To Jobbers

We Have an Unusually Attractive Proposition in Unallotted Territory. Write, Wire or Phone for Details.

The Profit Angle

Profits in the automotive industry can come in two forms—both substantially reflected in your bank balance.

The first profit is, of course, the genuine profit from your customers' satisfaction with satisfactory merchandise and the second is in the dollars and cents column of your ledger.

Both profits may be enjoyed by the dealer in Himico, the replacement transmission for Ford cars and trucks.

Would you know how to turn the present percentage of discount on Ford trucks to a figure of 28 per cent on gross sales?—Then ask for our explanation of the actual cash benefits accruing to progressive dealers who sell and install Himico transmissions.

Himico transmissions are genuine ***replacements*** for the original planetary transmission in Ford equipment. All band troubles are over when Himico ***replaces*** the drums and bands with a genuine sliding gear transmission, fitting the Ford engine and chassis without cutting or alteration.

The improvement in operation is nothing short of marvelous! Friction losses are reduced to a minimum and the amount of usable power delivered to the rear wheels makes a Himico equipped Ford the Superior truck or car in the low priced field.

For contractors, creameries, lumber dealers, coal and building supply dealers; doctors, salesmen, collectors and others whose use of a car or trucks is severe, the Himico-Ford will meet all needs.

There is a strong, increasing demand for this transmission. It is used in every state of the Union. You may share in the profits of its sale. Write today for particulars.

HINKLEY MOTORS, INC.

Builders of Hinkley Heavy Duty Automotive Engines

P. O. BOX F-839 **DETROIT, MICH.**

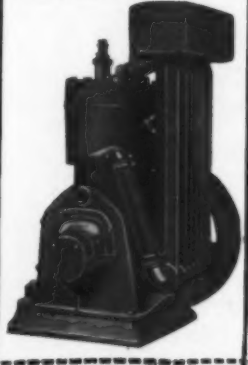
HIMICO
TRANSMISSIONS
POWER PLANTS

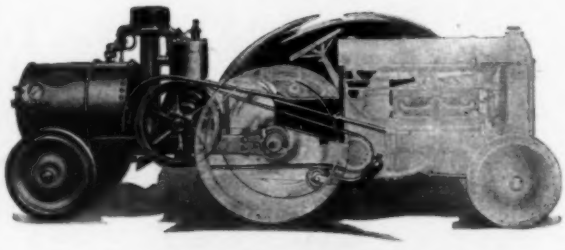
Invaluable for Breaking Paving and..

On a job like paving breaking the Curtis Portable Compressor enables two men to take the place of a whole gang working by hand. The saving in labor alone will enable you to greatly reduce your costs. The wages saved will pay for the cost of the compressor in a short time. Combined with the Fordson, the Curtis Portable Compressor moves right along with the men as they progress on the job.

...Many Other Uses

Such as: Rock hill side cuts, Backfill tamping, Quarry drilling, Riveting, Caulking iron pipe, Breaking boulders and similar jobs. It is the flexibility of the Curtis Portable Compressor, combined with the Fordson, that reduces costs and makes low bids possible.





A Rare Combination of Economies

The average contractor depends on low cost to keep his bids low. This means that he must demand low first cost, low operating cost and low maintenance cost, combined with finest quality, when he buys an air compressor.

The Curtis Portable Compressor and Fordson combined cost less than an ordinary engine-driven portable. If you have a Fordson, the cost is only about half as great.

The Fordson supplies power to run the compressor, as well as motive power for the unit, and runs on kerosone, which lowers operating costs.

The wide range of work applications of the Curtis Fordson Combined Unit, together with its simplicity and thorough dependability, make it an outfit that absorbs its "overhead" in a remarkably short time.

Send for illustrated bulletin C-4-B, which describes the Curtis-Fordson fully, with prices and uses. This bulletin will be sent to you free upon receipt of the coupon below. Mail it today. There is no obligation.

1854-Seventy-two years-1926

CURTIS Pneumatic Machinery Co.
1931 Kienlen Ave., ST. LOUIS, MO.
118-I Hudson Terminal, New York City

Please send me without obligation your free bulletin C-4-B.

NAME.....
ADDRESS.....
CITY.....STATE.....
Have you a Fordson?.....
What kind of work do you do?.....

CURTIS

COMPRESSORS-HOISTS-CRANES AND AIRMIST CAR WASH SYSTEM

The Pulse of the Job-Power!

CHICAGO'S Loop District is dotted with construction work. Back of high boarded partitions — huge buildings are in the making. The constant hum of machinery is its life, and **power** acts as the **pulse of the job.**

The Mid-Continent Construction Company is as busy as bees in the Loop. And **power** keeps the pace.

Two 75 ft. Conveyors—shown above—are powered by two Le Roi 4 cylinder engines. They elevate sand and gravel into high steel hoppers. As fast as materials are dumped they are speeded to the bins. There is no delay—for Le Roi power is dependable.

The Le Roi shows a surprisingly low average repair parts cost—it takes "time-out" less frequently—it stays active on the job long after the ordinary engine grows feeble—it is above all, vigorously "power-full"

Look to the Le Roi for dependable power.

LeRoi Company
Milwaukee

Engine Builders only!

LE ROI ENGINES
for dependable power!

A REAL PUMP

Built to stand the gaff. For dependability, capacity and suction lift, Humphryes High Capacity Diaphragm Pumps have no equal.

The outside guided discharge valve, non-clogging suction valve and large direct water ways are features which provide a simple, easily cared for, diaphragm pump which possesses the non-clogging features required for continuous and uninterrupted service.

Write for complete details.

The Humphryes Mfg. Co.

MANSFIELD OHIO

SPEARWELL BIG 8 GRADER MAINTAINER

Leads Them All.

30 to 35 Miles of Maintenance an average day's work at a total cost of from

$10.00 to $12.00

A Complete, Standard 8-ft. Grader Unit with all standard controls operated from driver's platform in rear.

Write for descriptive literature and prices.

SPEARS-WELLS MACHINERY CO., INC.

Manufacturers SPEARWELL Equipment

OAKLAND CALIFORNIA

HAND BUSH HAMMERS

A size for every bushing and dressing job on concrete.

We would like to acquaint you with the most complete line of Pneumatic tools and chisel equipment for bushing concrete and finishing cast stone.

Hand Points and Chisels.
Hand and Striking Hammers.
Drill bits and Hollow Steels.

Descriptive matter awaits your call

THE DALLETT CO.

PHILADELPHIA

NEW YORK CHICAGO

KIESLER

Clam Shell Buckets

Guaranteed to give satisfaction.

Catalog on request.

Jos. F. Kiesler Company

936 W. Huron Street, Chicago, Ill.

WARRENITE-BITULITHIC

MEANS UP-TO-DATE

Road and Street Construction

Write for illustrated booklet

WARREN BROTHERS COMPANY

Executive Offices: Boston, Mass.

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At Drawbar *and* Blade

Beaver Pulls and Pushes

Keeping power at the drawbar to pull and at the blade to push is one duty of the Beaver Engine. And that is its "call" on road construction and maintenance work, when it is used on tractors. There are steep grades to climb, difficult ground conditions to gain footing, and a pull of a few extra tons in wheel graders.

This is every day service for Beaver Engines. They measure up to heavy duty. On hard pulls or rough going, the Beaver is responsive and reliable—it runs smoothly and economically and does so consistently day-after-day.

But here is the "why" of Beaver dependability: valve-in-head design gets the maximum power out of every explosion; "oversize" working parts and remarkably vibrationless operation assure longer life; force-feed lubrication is fool-proof and trustworthy and its gas consumption is unusually low.

Insist on Beaver power on construction equipment—you can absolutely bank on dependable, long-lived power. Beaver Engines are made only for heavy duty—25 to 150 H.P. Write for bulletin describing the Beaver in detail.

BEAVER
Manufacturing Company
50 - 25th Street
Milwaukee Wisconsin

FOR STEADY SERVICE

Beaver

When writing to advertisers, please mention the Contractors' & Engineers' Monthly—Thank you.

START THE NEW YEAR RIGHT

Use Alamo Engines on your Equipment.

Alamo Engines develop their full rated Horse Power, and 10 per cent overload.

Any equipment manufacturer will be glad to furnish you an Alamo Driven Outfit.

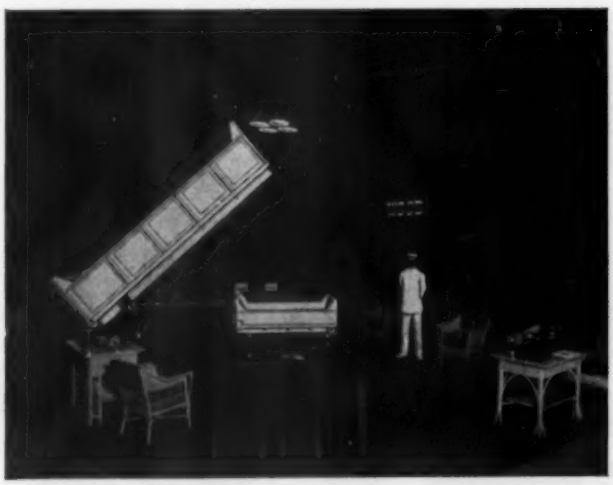
Write for folder

THE ALAMO ENGINE CO.
HILLSDALE MICH., U. S. A.

Builders of

Vertical and Horizontal Engines, in sizes from 1½ to 15 H.P., inclusive.

The SENSATION of the Show



Our De Luxe Exhibit at the Good Roads Show demonstrated to practical road builders the simplicity of Wood Hydraulic Hoists as an indispensable factor in every good roads construction program.

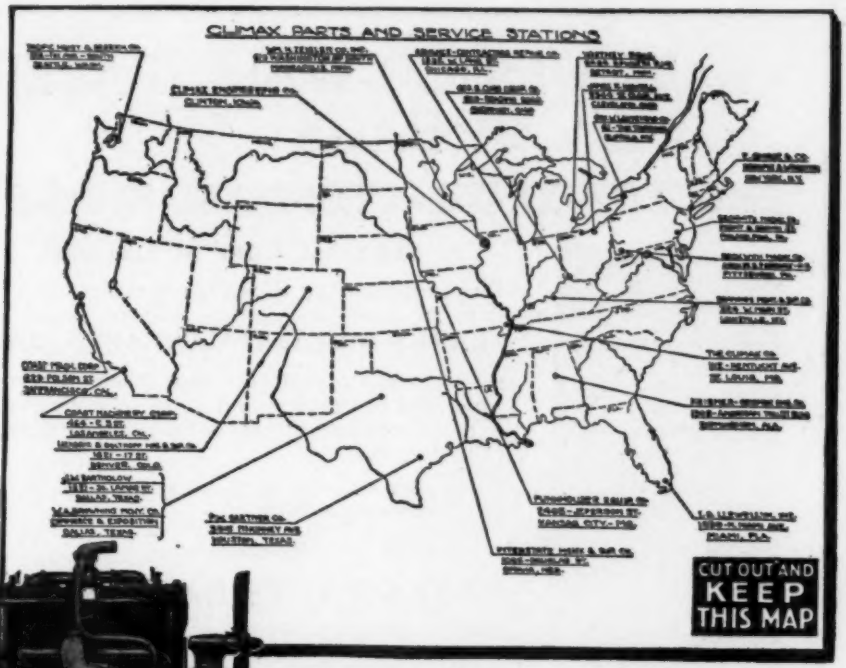
Write for illustrated folder in colors for construction details.

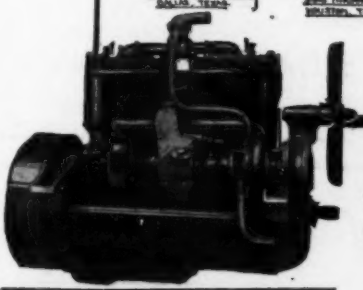
WOOD HYDRAULIC HOIST & BODY CO.

World's Largest Builder of Hydraulic Hoists and Steel Dump Bodies.

7936 Riopelle Street
DETROIT MICH.

7936





Always Near—If Needed QUICK SERVICE!

That's one of the extra values you get—absolute insurance against costly delays, if you specify that your machines shall be powered with—

CLIMAX

The "Trustworthy" Engine

Climax Service has a reputation for being as "Trustworthy" as the famous Engines that so seldom require it.

These well-known Manufacturers give you the additional protection of Climax nation-wide service, by equipping their product with Climax "Trustworthy" Engines:

Bay City Dredge Works, Bay City, Mich.
Brown Hoisting Mach. Co., Cleveland, O.
Byers Machine Co., Ravenna, Ohio
Davenport Locomotive Works, Davenport, Iowa
Equitable Asphalt Maintenance Co., Kansas City, Mo.
Fate-Root-Heath Co., Plymouth, Ohio
Four Drive Tractor Co., Big Rapids, Mich.
Galion Iron Works & Mfg. Co., Galion, O.
Greiman Ditcher Co., Inc., Garner, Iowa
Industrial Works, Bay City, Mich.
J. T. Tractor Co., Cleveland, Ohio
Kennison Mfg. Co., Solomon, Kans.
Keystone Driller Co., Beaver Falls, Pa.
Lidgerwood Mfg. Co., New York, N. Y.
Link-Belt Co., Chicago, Ill.
Locomotive Crane Co. of America, Champaign, Ill.
McMyler-Interstate Co., Cleveland, Ohio
Mid-West Locomotive Works, Cincinnati, O.
Moore Speedcrane Co., Chicago, Ill.
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J. S. Mundy Hoisting Engine Co., Newark, N. J.
National Hoisting Eng. Co., Harrison, N.J.
Northern Pump Co., Minneapolis, Minn.
O. K. Clutch & Mach. Co., Columbia, Pa.
Orton Crane & Shovel Co., Chicago, Ill.
The Osgood Co., Marion, Ohio
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Rix Compressed Air & Drill Co., San Francisco, Calif.
The Russell & Co., Massillon, Ohio
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1 W. 18th Avenue, Clinton, Iowa
Also Builders of Climax Refrigerating Units

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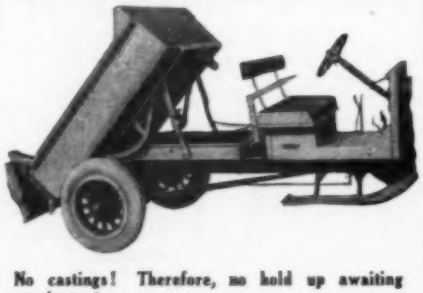

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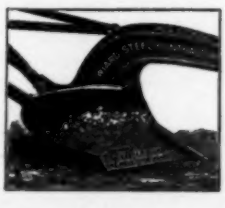

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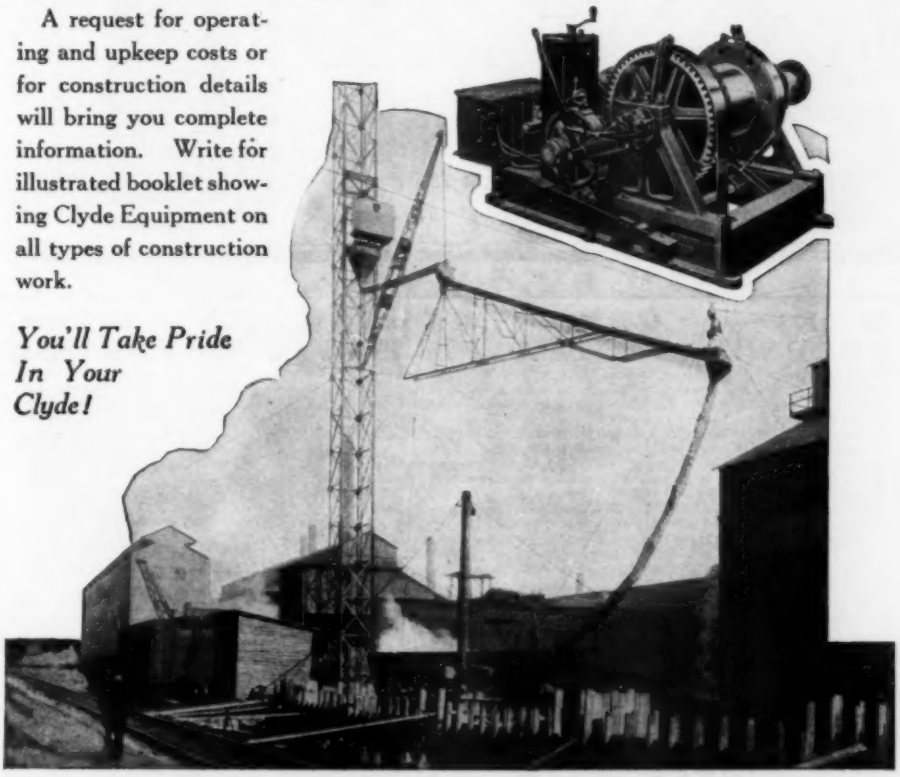

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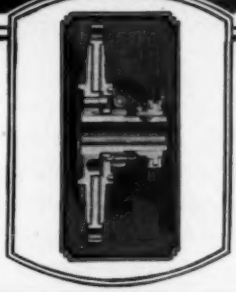

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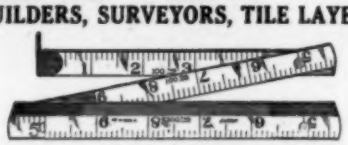

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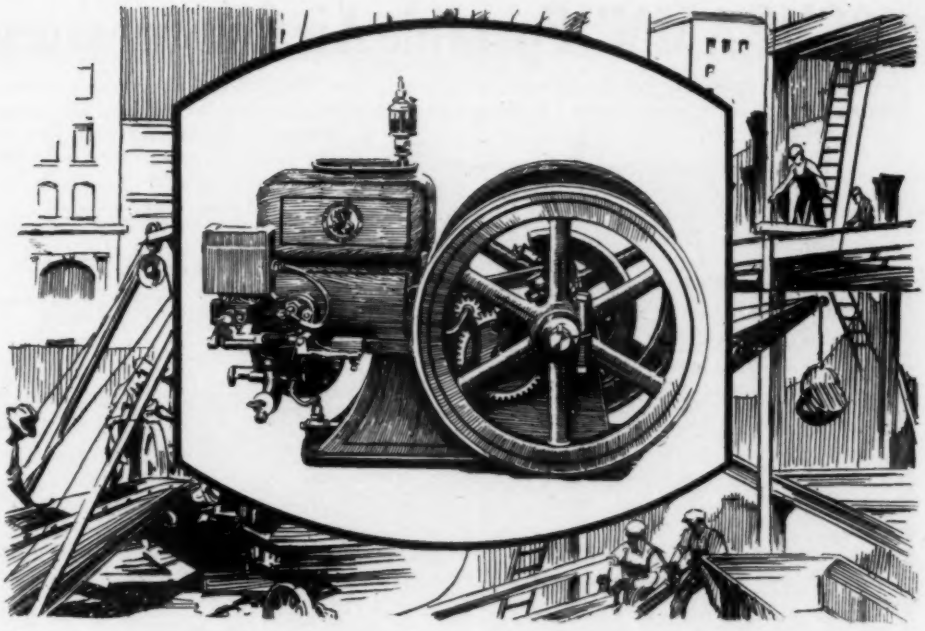

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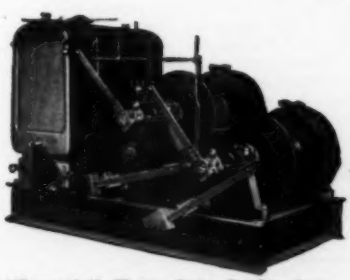

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"The joint should be of uniform

says H. J. KUELLING

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"The greatest error of the past in placing expansion material has been the failure to absolutely divide the concrete so that it touches at no point across the joint.

"Likewise, the joint should *always* be of uniform thickness, so that when pressure does take place, it will be uniform across the entire joint."

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For many years, Carey Elastite Expansion Joint has been the choice of successful engineers and builders, everywhere. Experience has indicated that one and one-half inches of Carey Elastite per 100 feet of pavement—or a one-half inch joint placed about every thirty feet—gives uniformly successful results. Today, enough Carey Elastite Expansion Joint is in use to carry out this idea—*always* providing a joint of uniform thickness—on a concrete road 37,000 miles long, 7 inches thick and 18 feet wide.

Finishing a transverse expansion and contraction joint in which Carey Elastite was used. This photograph was taken during the construction of State Trunk Highway 26, at Juneau, Wisconsin.

Carey Elastite Expansion Joint consists of two substantial layers of asphalt-saturated felt, between which is interposed a heavy body of asphalt compound, the whole being inseparably bonded together in sandwich form by mechanical pressure. Behind it is the reputation of The Philip Carey Manufacturing Company—a reputation based on fifty-two years of successful service to the building trades.

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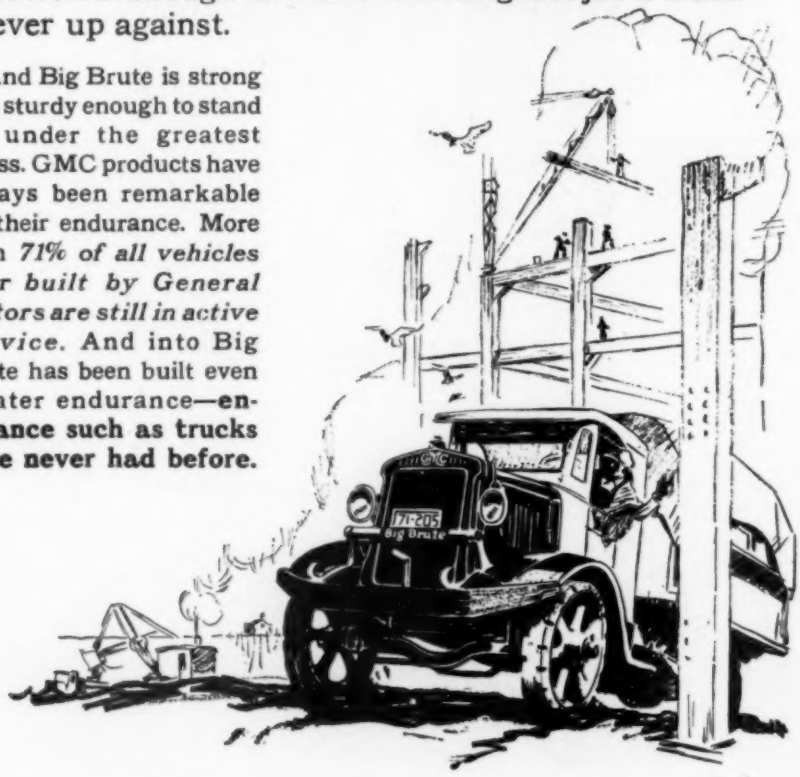

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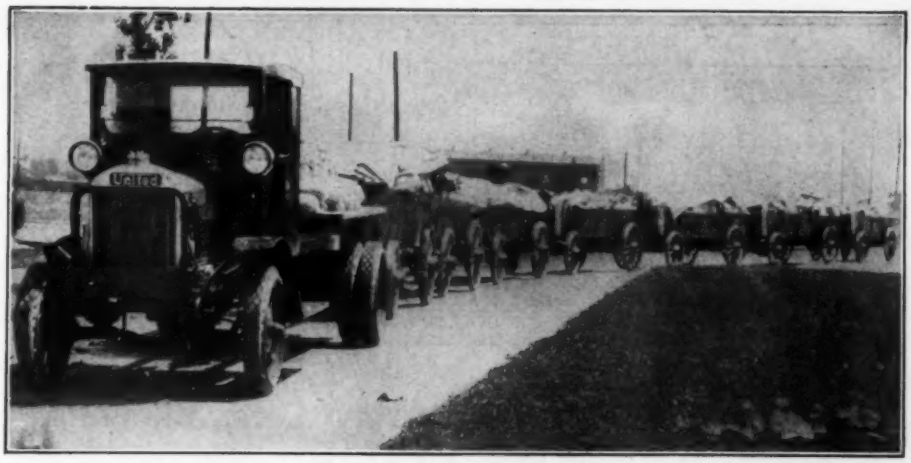

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"Quality Transportation Units Since 1910."

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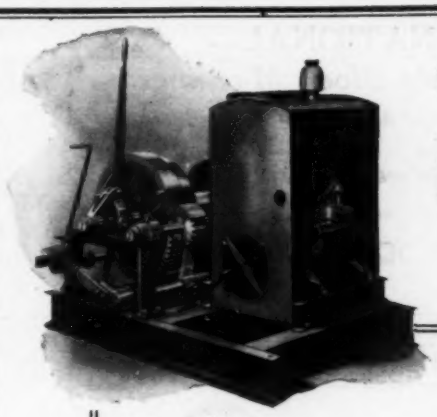

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SINGLE FRICTION DRUM

DOBBIE HOIST

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THIS Hoist is direct geared to a two-cylinder hopper-cooled gasoline engine, complete with governor, magneto, switch, carburetor and muffler. The bed frame is of structural steel; the drum clutch, the approved band friction type. Hand and foot levers are centrally located. A winch head is supplied with the hoist when ordered.

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Specifications of any type of Hoist or Derrick furnished on request.

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Concrete Block Machines

Anticipate the demands of the industry.

Thorough developed — Well built
Satisfactory Equipment

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The automatic depth control of the Euclid scraper particularly adapts it to the small tractor. Just lift the loading lever and the pull of the tractor does the rest. The scraper takes a nice smooth cut, gets a big load and does not stall the tractor or overwork the operator.

When the pan is full a light pull on the clutch rope raises it to the carrying position. At the dump another pull on the rope dumps the load in a pile or distributes it at will.

Write now for prices and discounts on Euclid Tractor Equipment.

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Some of the world's greatest records of yardage production on earth and stone moving projects have been made with

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Power Shovels
Electric-Steam-Gasoline-Electric

Marion Power Shovels have a world-wide reputation for low-cost yardage. They are famed for digging. Built in both revolving and railroad types, in capacities ranging from ¾-yd. to 8-yd., and with choice of powers and tractions. Come to Shovel Headquarters

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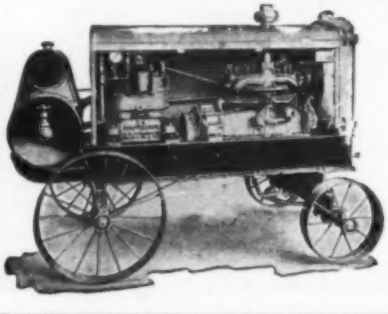

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SUMMARY OF ADVANTAGES:

Large capacity. Special carburetor control, saving your gas by idling the motor when not supplying air. CLUTCH FOR EASY WINTER STARTING. Rigid, compact, standard-make engine. Pump lubrication. Visible oil gauge and ignition switch. Ease of adjustment or repair. Reasonable price.

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118, 160, 265 cu. ft. piston displacement; Steel Wheels, Rubber Tires, Spring Mounting.

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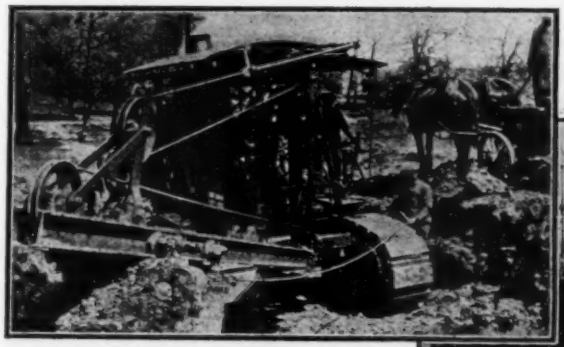
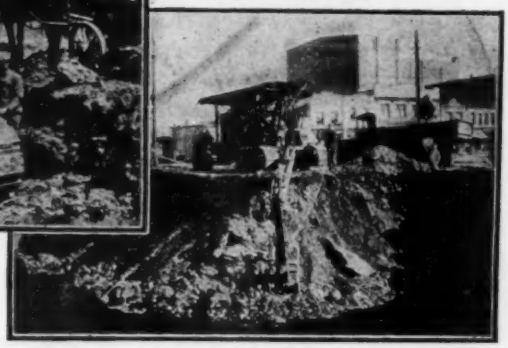


Above—Model 4 Keystone, Steam Drive, with ⅝-yard Skimmer. The bucket with a 14-foot crowd and a ten-ton thrust.

Below—Model 4 Keystone, Gas Drive, with Pull-stroke Ditcher Bucket. It stands on the solid and cuts any width or depth to 20 feet.



These are Original Keystone Features

THE original and out-standing Keystone ideas in earth excavation are the *Skimmer Scoop* and *Pull-stroke Ditcher Bucket*. They are fully covered by patents issued and pending.

The *Skimmer* is a heavy and effective ⅝-yard bucket, with bottom hinged at the toothed end, and is carried upon an 18-foot boom giving it 14 feet of horizontal digging travel. Cuts a swath 32 feet wide leaving a smooth surface, finished to grade—the bucket ideal for road and street excavation.

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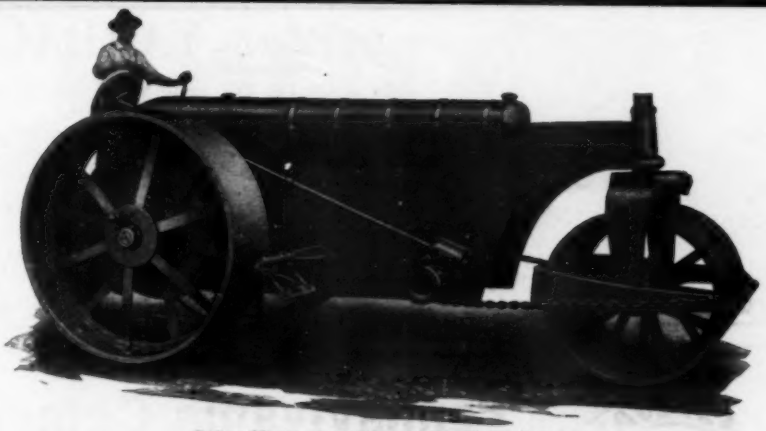

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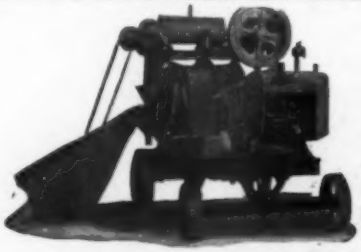

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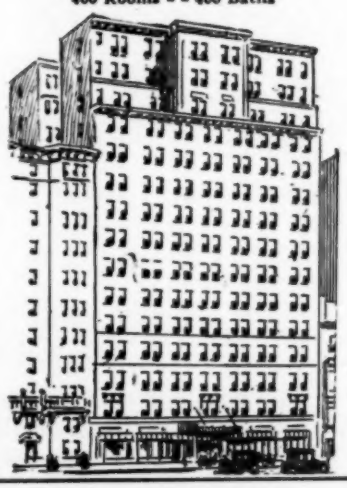

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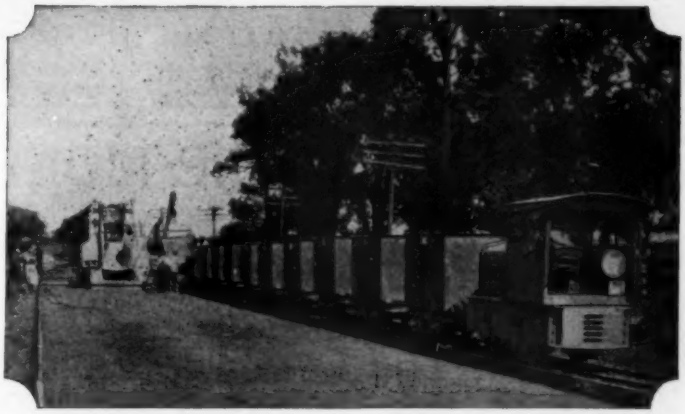

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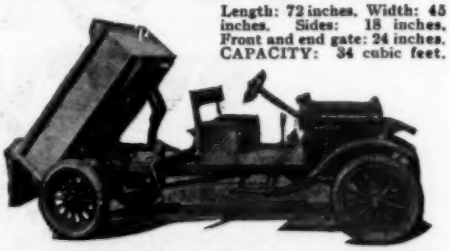

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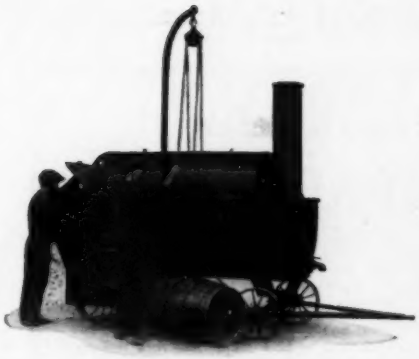

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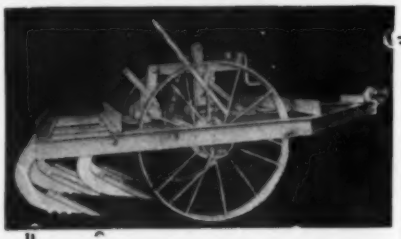

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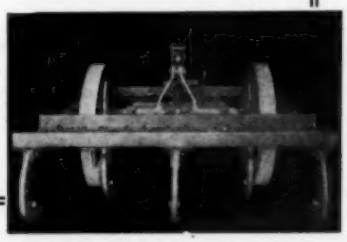

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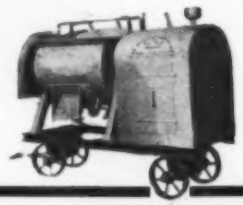

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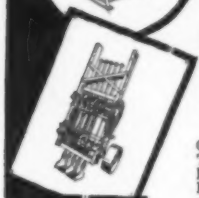

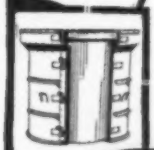

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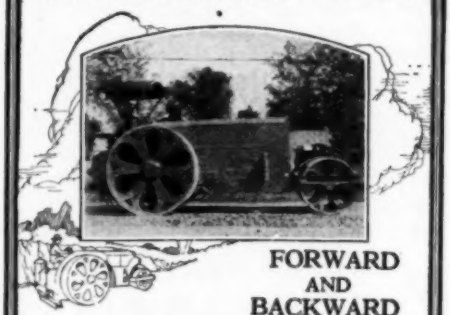

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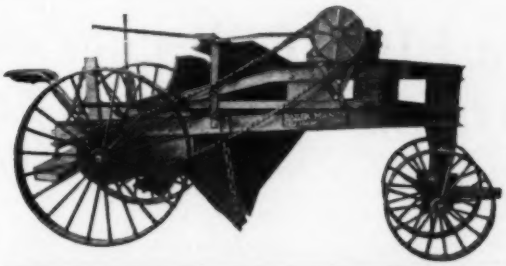

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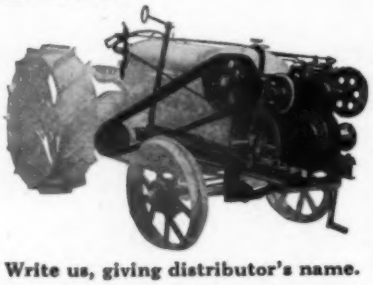

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"They put a man on his feet."

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BOSTON & LOCKPORT BLOCK CO.
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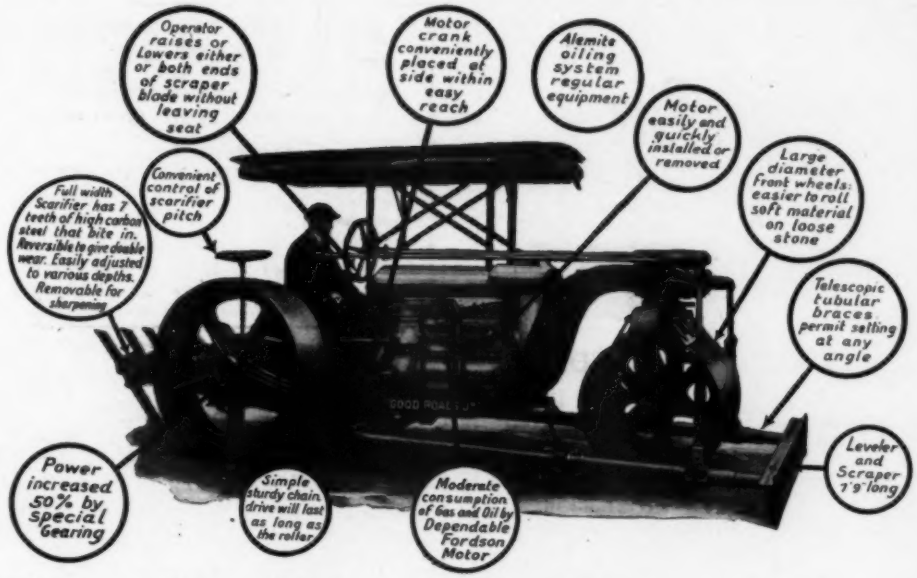
The "High Sign"

THE WAUGH sign on a Rock Drill, Drill Steel Sharpener, Concrete Breaker or Clay Digger, is the contractor's assurance of high speed, high efficiency, and completely satisfactory performance.

The Denver Rock Drill Mfg. Co.
DENVER, COLORADO


Operator raises or lowers either or both ends of scraper blade without leaving seat
Motor crank conveniently placed at side within easy reach
Alemite oiling system regular equipment
Motor easily and quickly installed or removed
Large diameter front wheels: easier to roll soft material on loose stone
Convenient control of scarifier pitch
Full width Scarifier has 7 teeth of high carbon steel that bite in. Reversible to give double wear. Easily adjusted to various depths. Removable for sharpening
Telescopic tubular braces permit setting at any angle
Leveler and Scraper 7'9" long
Power increased 50% by Special Gearing
Simple sturdy chain drive will last as long as the roller
Moderate consumption of Gas and Oil by Dependable Fordson Motor

Four Machines in One—
Good Roads, Jr. Roller

Our 1926 catalog is now ready. Send for it today. It contains an exhibit of Everything for the Road Maker.

HERE'S a road machine that cuts the cost of building and maintaining roads to a minimum. With a single small investment you have a complete outfit—road roller, scarifier, scraper and leveler—all in one.

This is what the Good Roads, Jr. will do:

1—Scarify a dirt, gravel, cinder or stone road.
2—Plane, grade and form the road bed.
3—Roll roads or drives—new work or maintenance.
4—Pull a sprinkler or grader or wagons loaded with materials.

All these operations are done well and at a very low cost. Roller is sold alone or with any or all the equipment. The consumption of gas and oil is extremely moderate. The roller is easy to operate—anyone who can run a Fordson can successfully handle it.

We will be glad to arrange for a demonstration.

Everything for the Road Maker

Road Graders
Road Drags
Road Oiling Machines
Heating Kettles
Rock Crushers
Steam Road Rollers
Tandem Rollers
Engine and Boiler
Corrugated Culvert Pipe
Gravel Screening Plants
Car Unloaders
Road Plows
Rooter Plows
Drag Scrapers
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New! Good Roads Motor Grader!

THE GOOD ROADS MACHINERY CO., Inc.
KENNETT SQUARE, PENNA.

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Combine Power and Traction with low-cost operation in Road Making, Snow Removal, Park Maintenance, Contracting and Hauling. Used by experienced Municipal, County, Township and State Highway Officials, Engineers, Contractors and Industrial Plants.

SIMPLEST IN DESIGN—MOST ACCESSIBLE
5- and 10-TON sizes.

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Watertown, Wis., U. S. A.

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FOOT OF PINE STREET
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Single Suction
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CENTRIFUGAL
Single Stage
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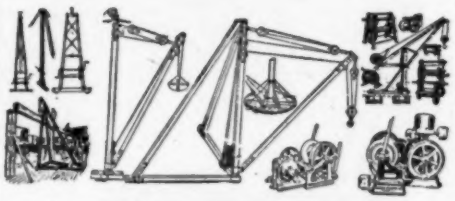

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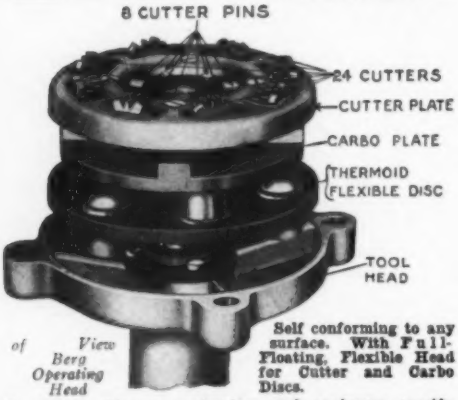

View of Berg Operating Head

Self conforming to any surface. With Full-Floating, Flexible Head for Cutter and Carbo Discs.

Leading architects, contractors and engineers specify BERG for efficient removal of fins, board or form marks and all surface irregularities from concrete. Used on some of the country's biggest jobs. Interior and exterior work. Supplied for either 110-125 or 220-250 volts, AC or DC.

Write for complete details and list of prominent users.

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Department F
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Are you paying for these machines?

Your own woodworking shop, right on the job, means lower costs, better bids and more jobs at greater profit. Ask for details on this Mortiser and other cost-cutting machinery.

Agents wanted for open territory

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SAW MILL MACHINERY CO.
Makers of Woodworking and Saw Mill Machinery
171 Main St. Hackettstown, N. J.

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"Built for service"

ALL STYLES
Portable and Stationary
25 to 200 gallons

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Municipal Index for the Kettle you need

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Write for Catalog.

THE JOS. HONHORST CO.
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"Caterpillar" Tractors reduce the risks on many a job.

They hold to their work in uncertain weather. They do not balk on cold days nor sulk on hot.

Ample traction increases their effectiveness on wet ground.

Simplified designs and quality materials insure a low upkeep cost.

Costs correctly calculated mean assured profits.

Prices on "Caterpillar" Tractors:

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SIXTY $5500
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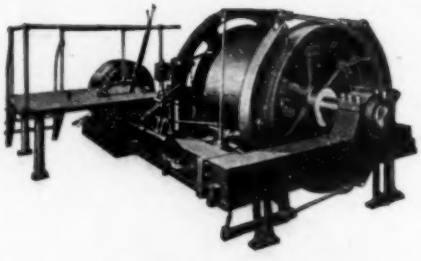
Building Hoists for a Half-Century

Flory also builds cableways, electric, steam, and gasoline and belt drive hoists, and dredging machinery.



When any company can serve the trade for fifty years,—its product must surely stand the test of time. Suffice it to say that Flory Hoists have more than made good,—you'll find them in use the world over.

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Tar and Asphalt Heaters

Style "A-1" is especially designed for maintenance work and is equipped with Connery's Improved Springs, ash pan and reinforced patented ribs. This heater can also be furnished with rubber tired wheels and roller bearings.

We manufacture a full line of Tar and Asphalt Heaters, Sand and Gravel Dryers, Oil Burning Heaters, Pouring Pots, etc.

Send for our little "Blue Book" illustrating our many specials in Tar and Asphalt Heaters—we build just what you want, for road work or general construction.

CONNERY & COMPANY, Inc.
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ASPHALT SURFACE HEATERS AND PATCHERS

$1000 in Hauck Surface Heaters Saves $12,127.00 per Year

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OIL BURNING SMOKELESS

Tar, Pitch and Asphalt Kettles
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No Sparks—No Smoke—No Ashes—Just Heat!

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1-2 Yard Crawler Crane---Dragline---Shovel

A speedy, powerful machine that handles a wide range of work economically.
Write for Bulletin describing Mead-Morrison features of operation.

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BUFFALO-SPRINGFIELD ROLLERS

All Types and Sizes
With or without Scarifier attachment.
Helps you finish the job on time.

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The Buffalo Springfield Roller Co.
Springfield, Ohio.

Trackpull Equipped Fordson

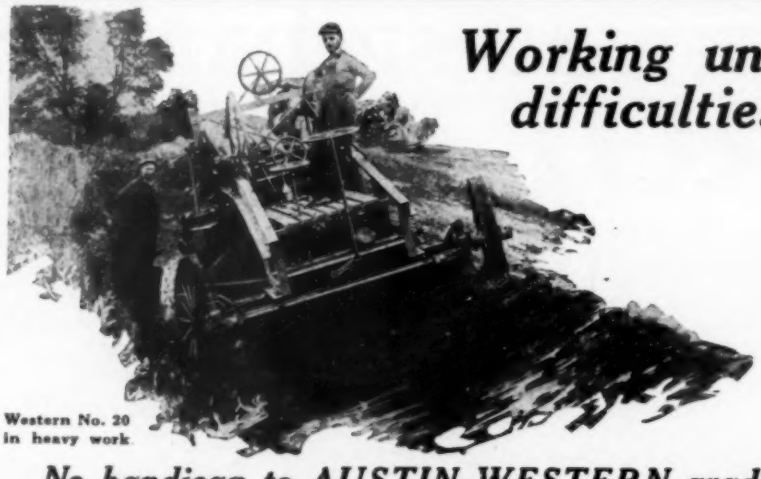
Lowest Cost Crawler Power

Wherever wheel type traction is difficult or impossible, the TRACKPULL gives to the Fordson a capacity for powerful and economical service.

In design and construction the TRACKPULL measures up in every particular to Fordson construction. Upkeep cost of this combination of Fordson and TRACKPULL is the lowest of any crawler type tractor.

Ask your nearest Ford dealer about the TRACKPULL and our unlimited guarantee of its proper performance.

BELLE CITY MANUFACTURING COMPANY, RACINE, WISCONSIN



Western No. 20 in heavy work

Working under difficulties

No handicap to AUSTIN-WESTERN graders

For over 40 years Austin-Western graders have met and defeated all obstacles and problems in highway construction. With thousands of these machines demonstrating their supremacy, sales are increasing yearly. ***Send for our big grader catalog.***

Catalogs of Rollers, Crushers, Sweepers, Sprinklers, Road Oilers, Dump Wagons, sent on request.

The Austin-Western Road Machinery Co.
400 N. Michigan Ave. Chicago, Illinois

You Should See The MIAMI Operate--- Then You'll Appreciate it---

Our claims of the Dirt Moving ability of the Miami Scraper are of no avail—they seem almost unbelievable to contractors who are accustomed to the high cost of old time methods.

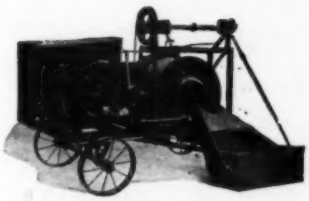
You must see this—one man operated—scraper on an actual job to appreciate the amount of dirt that can be moved in a day, and at a very low cost.

Get in touch at once with your local Ford dealer or write us direct for complete information regarding this cost cutting equipment.

Improvements just added have made the Miami-Scraper absolutely foolproof.

THE MIAMI TRAILER SCRAPER CO.
610 S. Clay St. Troy, Ohio.

MIAMI -one man- power SCRAPER
Reg. U. S. Pat. Off.



The "Panama" Line IS THE SHORTCUT

to bigger profits through a greater day's work with less labor. All the way from a large batch mixer with side loader or platform down to the small hand power mixer, there is that high quality of material, workmanship, and performance which has typified the Panama Line for years.

Panama Mixers assure a more uniform mix, and in time, labor and money quickly save their cost.

Write for the Panama Catalog and learn more of this profitable line of quality mixers. Also on Panama Concrete Block making machinery.

The J. B. Foote Foundry Co.
Established 22 Years
32 Front Street Fredericktown, Ohio.

SPRING RAINS

Wash outs, pools of water and poor drainage go hand in hand with spring rains.

The firmness of any road rests upon dependable drainage.

Collapsed culverts and open ditches are the causes of many detours and anguish to highway users.

You can make repairs, quickly, economically and for a generation to come by installing

NEWPORT "Genuine Open Hearth Iron" CULVERTS

which are

.. "CORRUGATED FOR STRENGTH AND GALVANIZED FOR LIFE"

EASILY INSTALLED BY UNSKILLED LABOR

If you have an unusual drainage problem write our engineering department and we will help you solve it.

THE NEWPORT CULVERT CO
Newport Kentucky

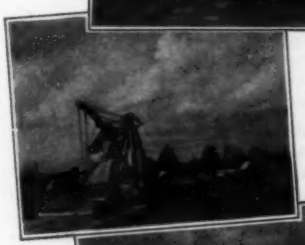
Write for descriptive literature and further data.

For

CONCRETE ROADS

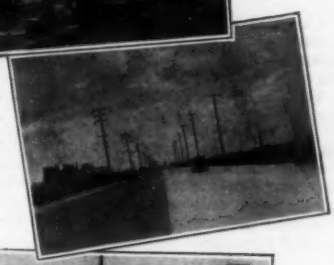
CONSTRUCTION—CURING—PATCHING

A section of the Lincoln Highway



Note how closely the curing follows construction

Comparative view showing "clean" pavements through use of Solvay



A patching job made easy with Solvay

Solvay Flake Calcium Chloride when used as an admixture with Portland Cement in the construction of concrete roads produces early tensile strength, and increases the final strength. It sets the interior as fast as the surface, producing one solid mass, and hardens the concrete in about one half the usual time.

SOLVAY

Calcium Chloride

The period of time required for satisfactorily curing concrete roads has been reduced to as little as 7 days by using Solvay Flake Calcium Chloride as the curing agent.

Conclusive tests prove that concrete cured with Solvay is made harder and denser, increasing length of service. No water line is necessary because daily sprinkling is eliminated. By using the Solvay Spreader, one man in two or three hours can cover all the concrete poured in a day. There is no expensive "clean-up" when Solvay is used.

Solvay Flake Calcium Chloride has been approved by state, county, and city highway departments and engineers and unquestionably presents the one certain, economical, money-saving method for curing concrete oads.

Patching concrete—When Solvay is mixed with Portland cement it accelerates the set and gives it early strength. These qualities are extremely valuable in patching, and have caused Solvay to be widely used for that purpose.

Write for Booklet No. 2051

THE SOLVAY PROCESS COMPANY

Wing & Evans, Inc., *Sales Department*

40 RECTOR ST. NEW YORK

5 Savings On Your Next Concrete Job!

First—No large group of laborers need be left behind to cover the pavement for curing. They can all be sent ahead to push along the grading, curbing, placing of forms, and all the jobs that have to be done to get ready for the mixer. No earth cure is needed with Dowflake. You don't need to worry about where to get the right kind and amount of earth for curing—how far to haul it, nor where to dispose of it. You don't need it.

Second—The use of moisture providing Dowflake never interferes with full time mixer operation. With Dowflake you never have the mixer shut down to save water for curing. Dowflake provides its own supply of moisture.

Third—You can use the same forms and equipment over and over instead of having them tied up in slow jobs because quicker curing releases forms and equipment.

Fourth—Your capital does double duty when Dowflake cures the pavement. You avoid arguments with the inspector about the correct amount of moisture, for Dowflake not only provides the supply of moisture, but regulates it. You get quicker curing and get your money quicker. You save detour maintenance costs.

Fifth—When the curing is completed, you do not have to wait for earth to be scraped up and cleaned off. Dowflake leaves the pavement clean; when your through paving, your through curing, so far as you are concerned, and a nice clean pavement is ready for quick official O. K. and payment.

THE DOW CHEMICAL COMPANY
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Branch Sales Offices
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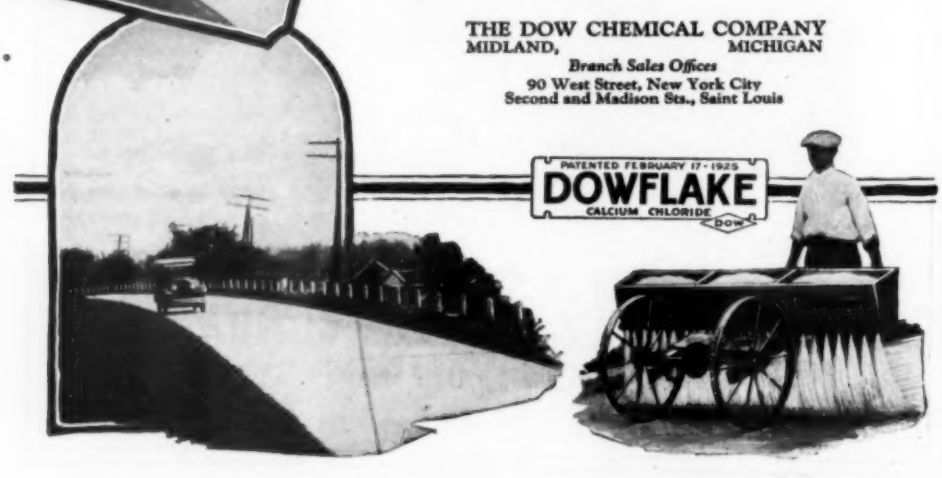

WILSON STREET, Eau Claire, Wisconsin, is smooth and dry in all weather. The frosts of winter do not injure it, and the heavy spring rains cannot penetrate its waterproofed surface. And during the summer months, residents along Wilson Street never have reason to complain of dust.

Wilson Street has been treated five times in the last ten years with

Standard Asphalt Road Oil

Any community may have streets like this without a heavy expenditure of money. Standard Asphalt Road Oil offers the most economical means of putting streets and roads in first class condition.

Our engineers will be glad to make a survey of the roads and streets of any community which is contemplating road improvement, and recommend the correct grades of road oil or asphalt to meet the conditions.

No charge is made for this service. Phone or write our nearest branch to make arrangements.

STANDARD OIL COMPANY
(INDIANA)

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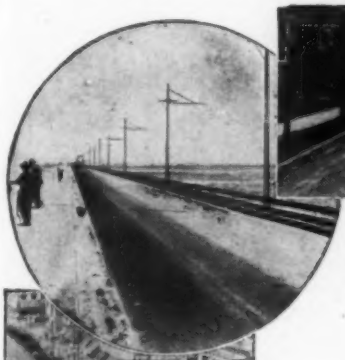
	South Bend						

New Streets for Old!

This "Kyrock" surface laid on old macadam in Bedford, Ind., makes a perfect street, saves tax-payers investment in old roadbed, and stops repair expenses.



This "Kyrock" surface on Biscayne Bay Causeway, Miami, has carried 8,000 vehicles a day under Florida sunshine for seven years. Not a crack or roll in it today.

A "Kyrock" surface transformed this worn brick street of Asbury Park, N. J., into a noiseless, resilient pavement at small cost. A section of 18th Ave., N. (Bostick St.), Nashville, Tenn., surfaced with "Kyrock" in 1888, is perfect today after 38 years of service without repair to foundation or resurfacing. "Kyrock" stays put.

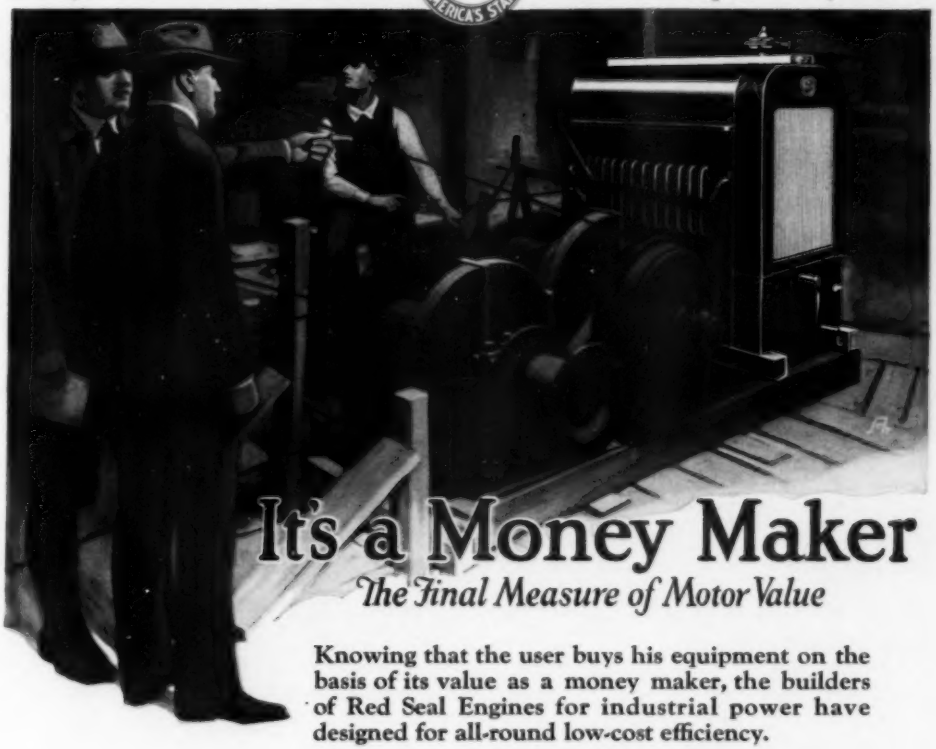
WHETHER you pave for beauty or utility, "Kyrock" (Kentucky Rock Asphalt) is the logical surface. It is non-reflecting, and more nearly skid-proof than any other. Smooth and *resilient*. It will not crack or wave on any negotiable grade in any climate. "Kyrock" is blasted out of the hills of Edmonson County, Ky.—ready mixed by nature. It is laid *cold*—without the extra cost of asphalt experts, inspectors, or expensive equipment. Its laid-cost is no greater and its maintenance cost less than any other high-type surfacing. "Kyrock" has *proved* its better worth as a wearing surface over every type of road base, under the extremes of climate and traffic. These installations speak convincingly of lower costs and longer life, to any community now planning street or road paving.

KENTUCKY ROCK ASPHALT CO.
INCORPORATED
LOUISVILLE KENTUCKY

Kyrock
The **Perfect Pavement**

KENTUCKY ROCK Kyrock ASPHALT

Dependable Power for Every Purpose



It's a Money Maker

The Final Measure of Motor Value

Knowing that the user buys his equipment on the basis of its value as a money maker, the builders of Red Seal Engines for industrial power have designed for all-round low-cost efficiency.

Red Seal Engines are built to yield the greatest possible power output over the longest possible period of time at the lowest possible cost—including first cost, maintenance cost and operating cost.

This is the final measure of engine value and covers long life, dependability, and economy. Such a power unit yields the owner tangible returns on his investment.

Put Your Power Problems Up to "Power Headquarters"

CONTINENTAL MOTORS CORPORATION

Offices: Detroit, Mich., U. S. A. *Factories:* Detroit and Muskegon

The Largest Exclusive Motor Manufacturer in the World

Continental Motors

1. Tray shaped to handle sloppy material.

2. Handles of selected Michigan Hardwood.

3. Handles 20½ in. from ground. You don't have to break your back to reach them.

4 Steel angle legs rigidly braced. Heavy shoes below.

5. Nose of barrow especially designed for easy pouring.

6. A heavy rod in top of tray.

7. Extended handles. Ends bound with steel yoke.

8. Pressed steel bushings in hub of wheel.

F-4½ Concrete Barrow
Capacity 4 cu. ft.

Lansing Wheelbarrow Economy

"Lansing Equipment for Contractors"

Mixers
Batch
Continuous
Mortar
Barrows
Carts
Scrapers
Hoists
Block
Machines

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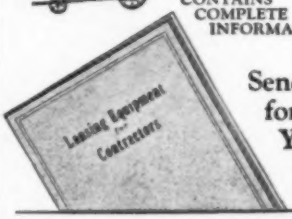

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This wide selection combined with the best of quality and workmanship and an unequalled quick distribution and parts service have won for them this enviable reputation.

The use of Lansing Wheelbarrows by new institutions means an added source of economy for them.

Contractors and purchasing agents be sure that your files are complete with the Lansing Company catalogue.

LANSING COMPANY, LANSING, MICHIGAN

BRANCH WAREHOUSES

Chicago Boston Minneapolis San Francisco New York Kansas City Philadelphia

LANSING COMPANY
EQUIPMENT FOR CONTRACTORS

Distributors of Contractors' Equipment

THE following cards (arranged by states) show the names of dealers in contractors' equipment and supplies with a record of the various lines handled. Contractors will find this list a convenient means of getting in touch with dealers who make a point of giving satisfactory service and prompt shipments. This directory is constantly consulted by our subscribers and any suggestions regarding it will be welcomed. : :

ALA.

C. B. DAVIS ENGINEERING CO.

Brown Marx Bldg. **Birmingham, Ala.**

CRANES	CRUSHING EQUIPMENT
HOISTS	DREDGES
CONVEYORS	PUMPS
BELTS	BUCKETS

REPRESENTING

Robins Conveying Belt Company
Morgan Engineering Co.
Nordberg Mfg. Co.
Wheeler Condenser Co.
Aldrich Pump Company
Bay City Dredge Works
Williams Bucket Co.

JOHN D. TURNER

1905 First Ave. Birmingham, Ala.
(Morris Hotel Lobby)

MATERIAL HANDLING EQUIPMENT

REPRESENTING

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Easton Car and Construction Co.—Industrial Cars and Track-Turntables, Roll Over Dump Bodies.
Lakewood Engineering Co.—Concrete Construction and Road Building Equipment.
Nordberg Manufacturing Co.—Trackshifters, Shoveloders.
Northwest Engineering Co.—Crawler Cranes, Draglines, Shovels.
Shaw-Enochs Co.—SHAWNEE Road Builder and Maintainer.
Universal Crane Co.—Truckcranes.
Geo. D. Whitcomb Co.—Electric and Gasoline Locomotives.

The Young & Vann Supply Co.

Birmingham, Ala.

Complete line of Contractors' Equipment and Supplies.

REPRESENTING

Smith Concrete Mixers and Pavers
Novo Hoists, Pumps, etc.
Blaw-Knox Steel Forms, Batcher Plants, Clam Shell Buckets
Thew Gas, Steam and Electric Shovels
Baker Backfillers and Unloaders
Archer Concrete Towers
Watson Dump Wagons
Red Edge Shovels and Picks
Akron Wheelbarrows
Carey Elastite Expansion Joint
M. & M. Form Clamps

CALIF.

The BROWN-BEVIS CO., Inc.

470 East Third Street
Los Angeles, California

DISTRIBUTORS

T. L. Smith Co.—Concrete Mixers, Pavers and Excavators
J. D. Adams and Co.—Adams Leaning Wheel Graders.
Byers Machine Co.—Hoists, Cranes and Truckranes
Wood Shovel & Tool Co.—Wood Molybdenum Shovels
Lakewood Engineering Co.—Concrete Placing Machinery and Road Finishers
Geo. Haiss Mfg. Co.—Truckloaders and Conveyors
Barnes Mfg. Co.—Barnes Pumps
The Owen Bucket Co.—Clam Shell Buckets
The Buckeye Traction Ditcher Co.—Curb and Trench Ditchers
Watson Truck Corporation—Dump Wagons
Universal Crusher Co.—Crushers.
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438 E. 3rd St. **Los Angeles, Cal.**

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Iowa Mfg. Co., Rock crushers.
Koppel Sales Co., Cars and rails.
J. S. Mundy Hoisting Engine Co., Steam, Electric and Gasoline hoists.
Northwest Engr. Co., Gasoline & full Diesel shovels, draglines and cranes.
Northern Engr. Works, Electric overhead traveling cranes.
Deister Concentrating Co., LEAHY No-Blind vibrating screens and concentrators.

Concrete Machinery & Supply Co.

2014 Santa Fe Ave., Los Angeles, Calif.

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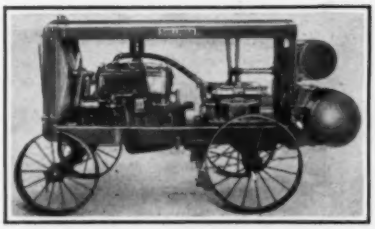

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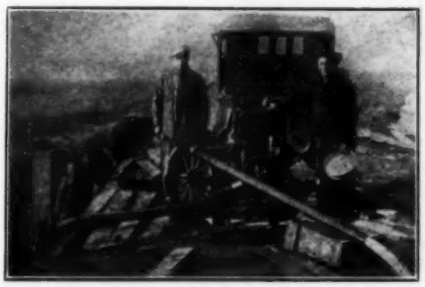

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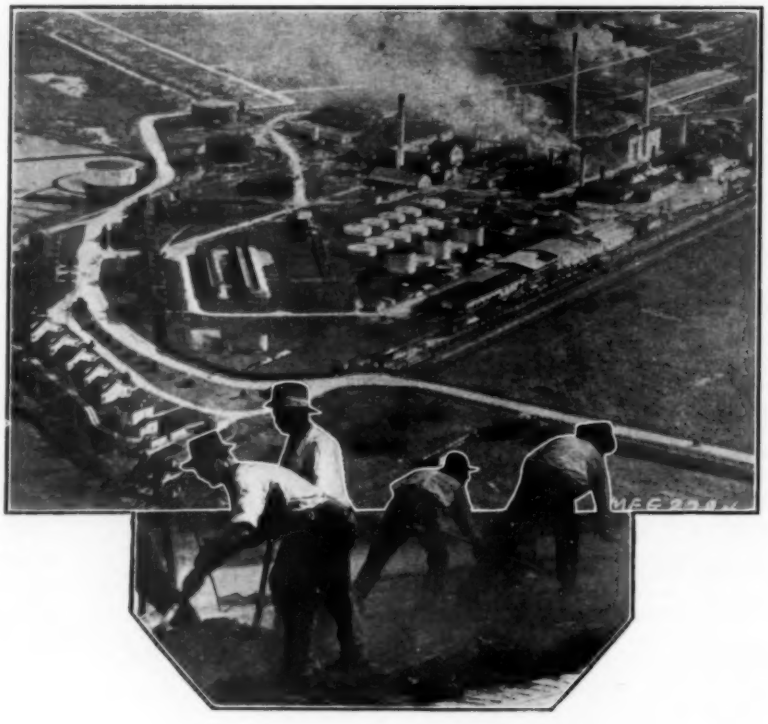

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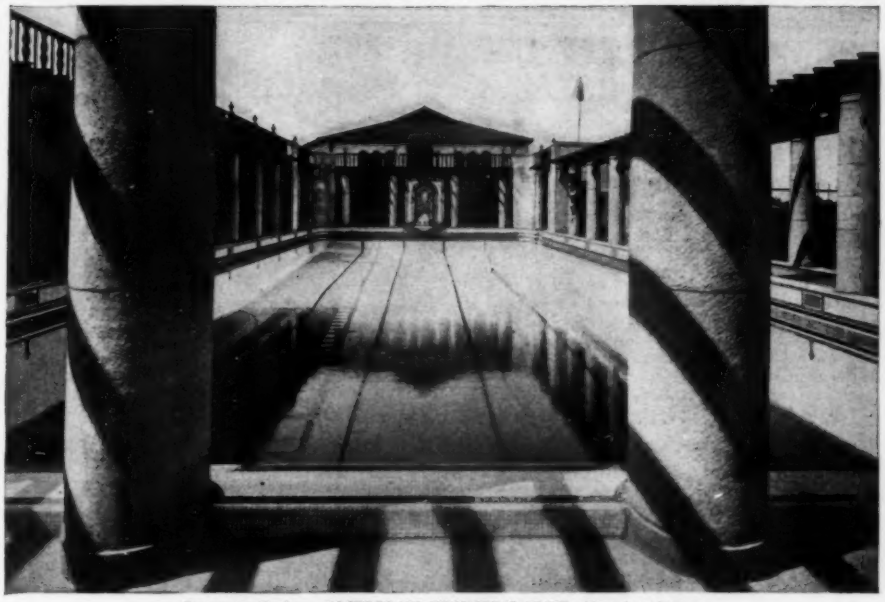

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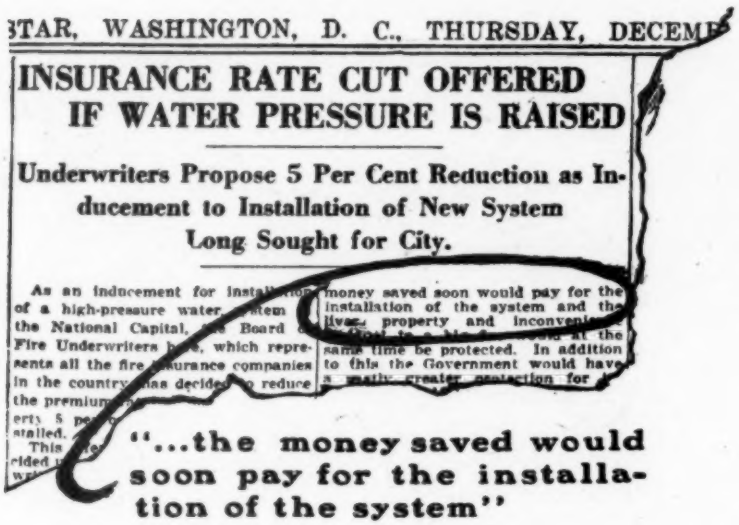

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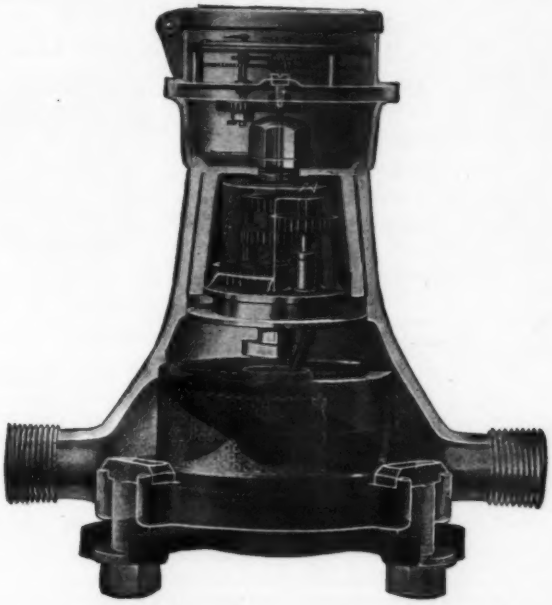

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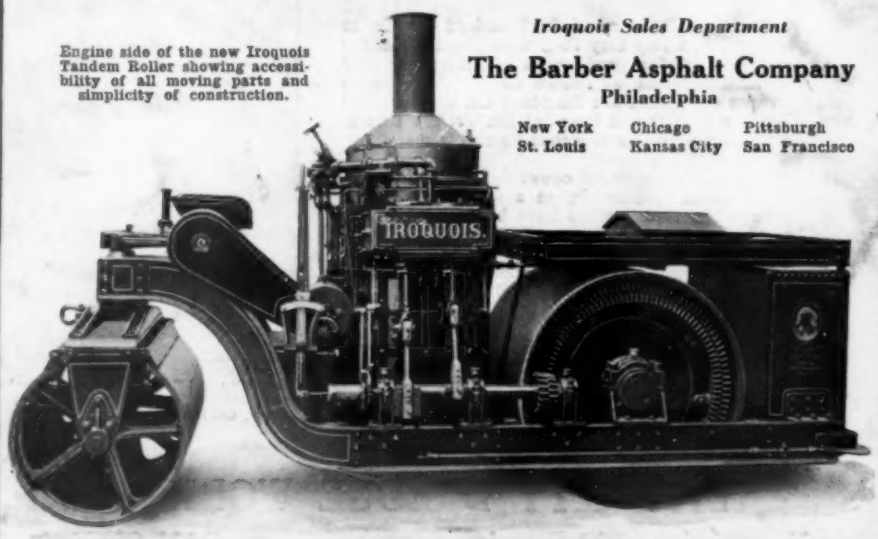

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